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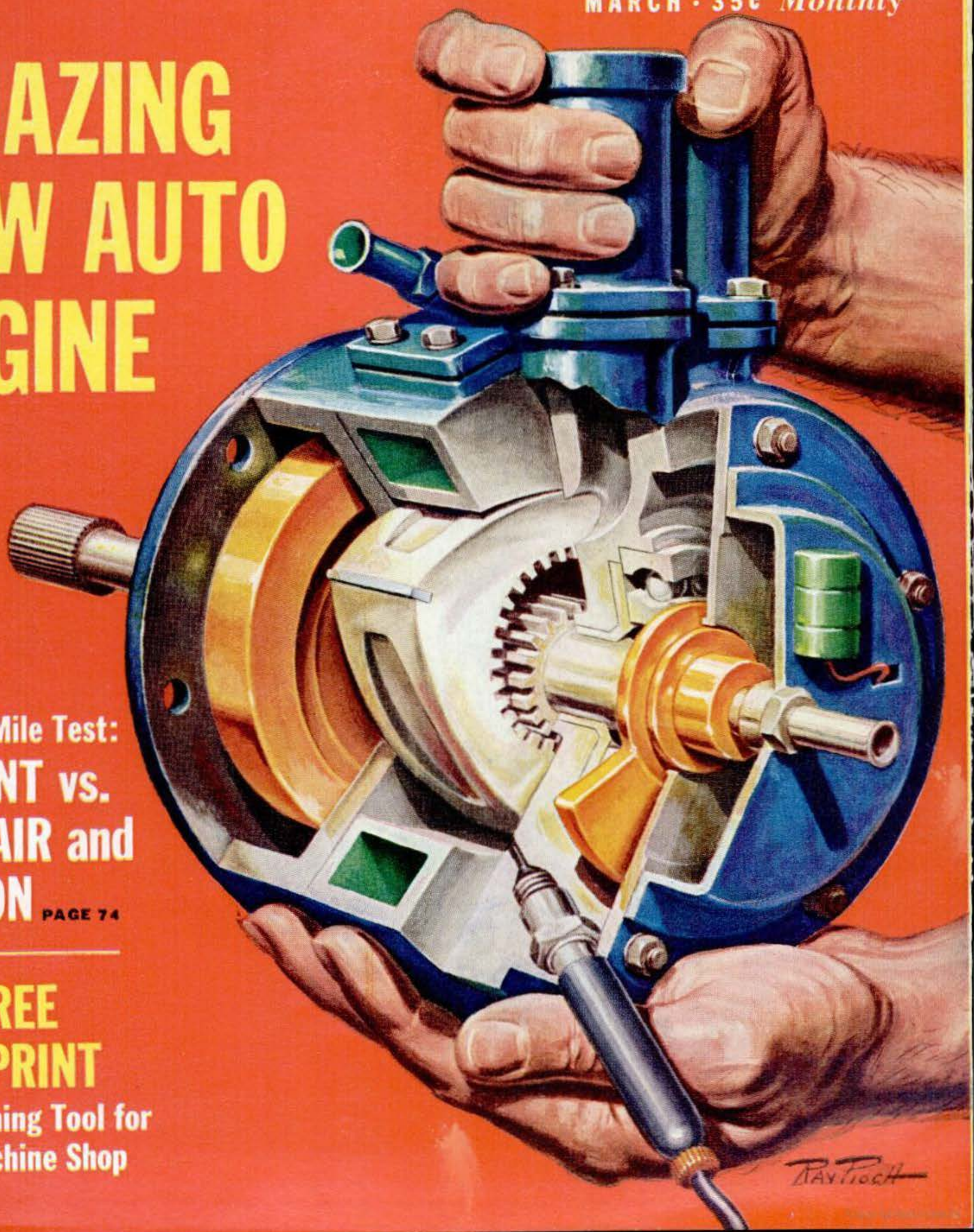
MARCH · 35c *Monthly*



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PAGE 82

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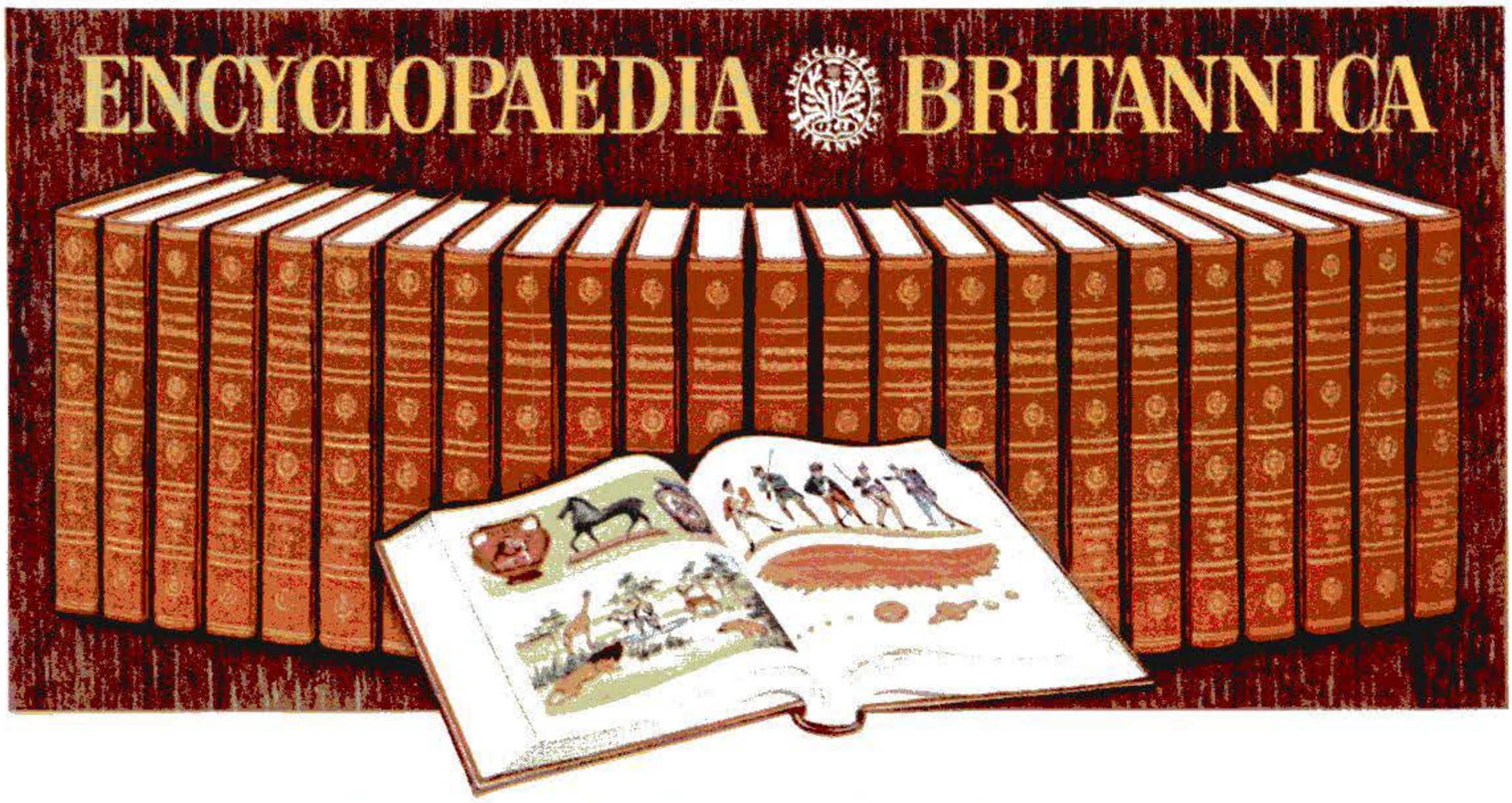

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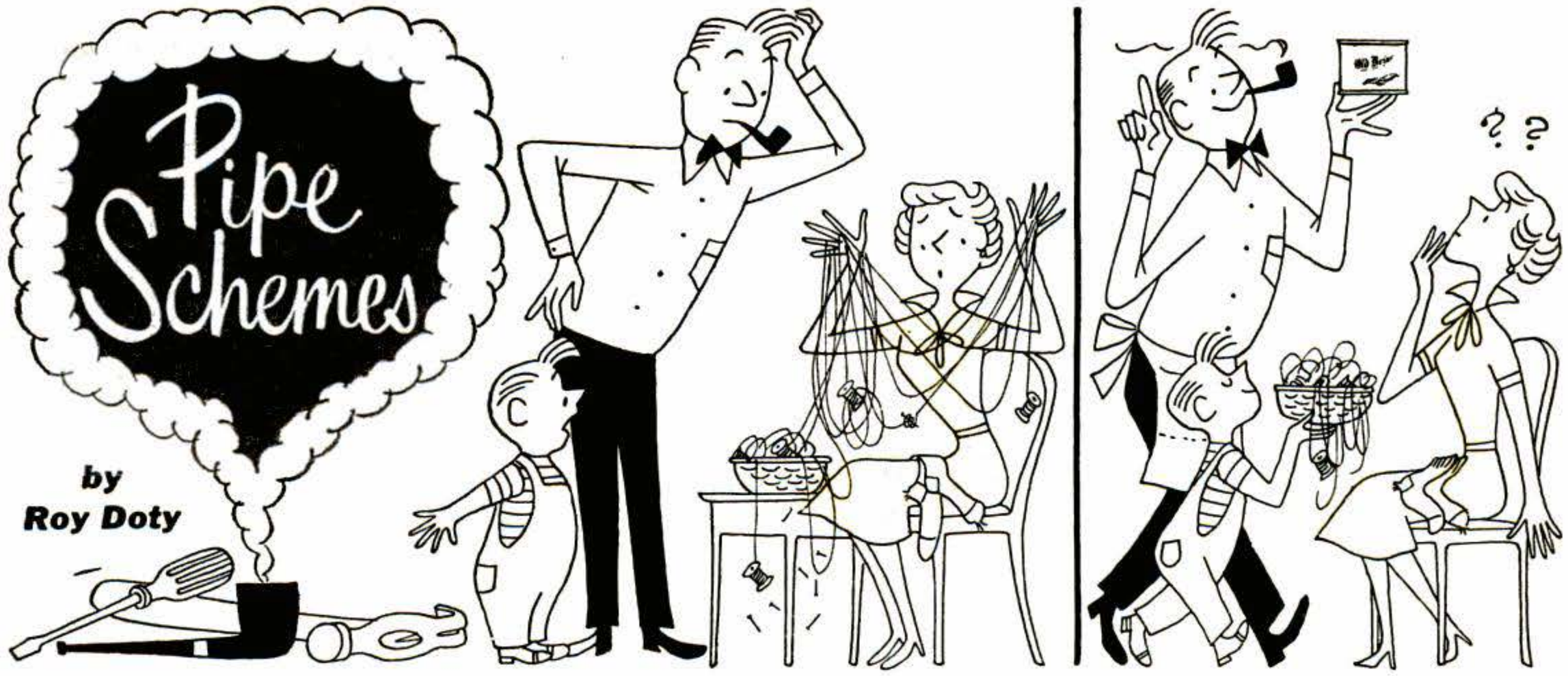

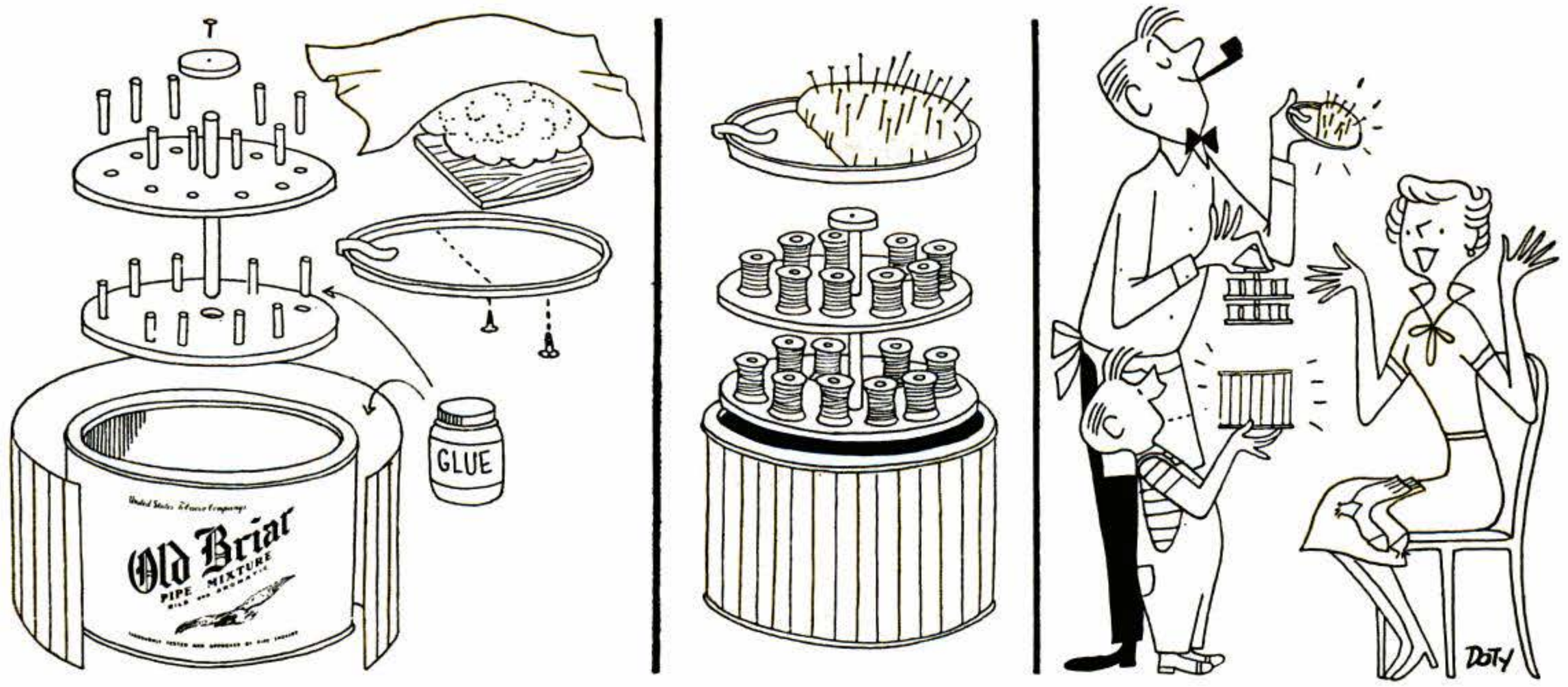

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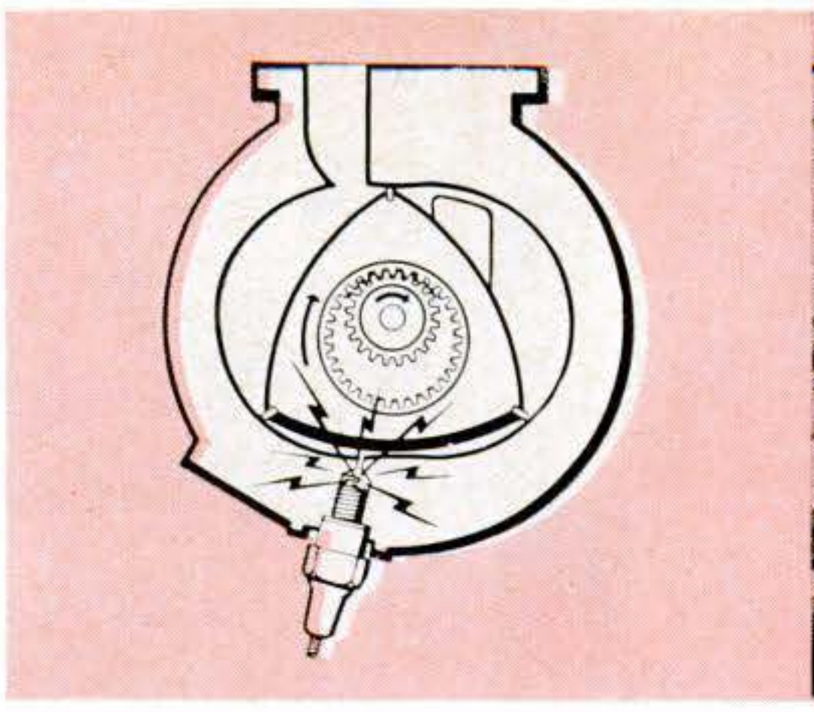
CONTENTS

Big Mac: *Ready for the yearly ice battle. P. 69*



Rotary Engine: *The shape of things to come? P. 82*

Rolling Vault: *Loaded with cash—and for bear. P. 88*

Founded in 1872 Vol. 176 No. 3 *Mechanics and Handicraft* REG. U. S. PAT. OFF.

Popular Science

March, 1960

Cover painting by Ray Pioch

CARS AND DRIVING

10,000 Miles in a Valiant..... 74
Auto Engine Without Pistons..... 82
Truckers Rebuild Antiques.....116
Ford's Not-So-Compact Comet.....118

DISCOVERIES AND INVENTIONS

New Camera Tube Brightens TV.. 92
Family Bus Takes to Water.....114

PICTURE NEWS

Prop in Tube Pushes New Tug.... 87
Garage Is a Double-Decker.....113
New Phone Hides in the Wall.....121
Front Man Blasts Off Last.....124
Half Boat and Half Tent.....138

SPECIAL FEATURES

Cracking the Great Lakes Ice..... 69
Deadly Harvest from the Sea..... 72
Riding with a Million in Cash..... 88
The Dangerous Black Widow.....106
Secrets of Working in a Group....109
How a Home-Movie Editor Works..122
World's Biggest Ship.....126
Folk Toys Are Back Again.....144
Can You Moor a Boat?.....175

SCIENCE AND INDUSTRY

Hiding Our Titan Missiles..... 94
Machines Lay Rails Faster..... 98
Coal Travels Through a Tube.....134

CONSUMER NEWS

What's New 128
Those Compact Hi-Fi Speakers....132

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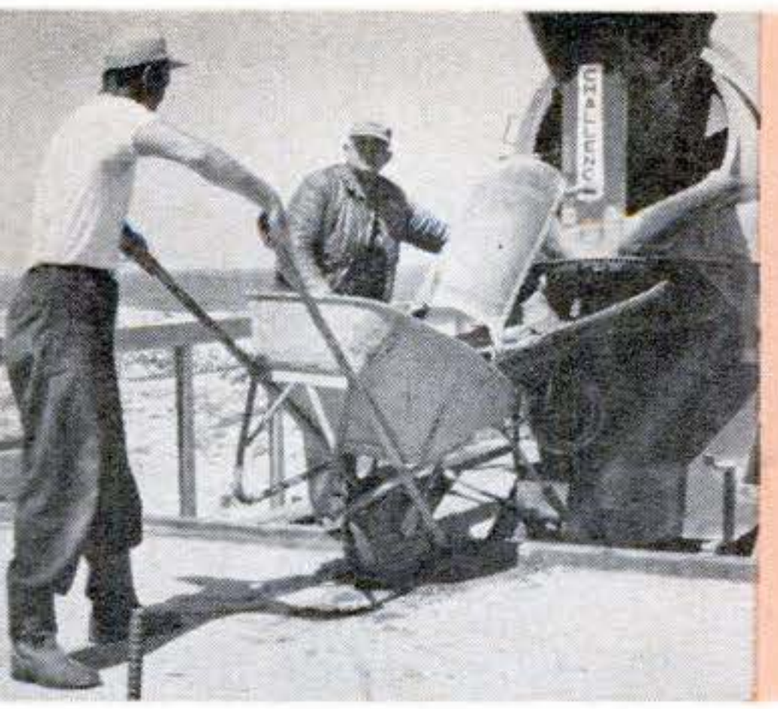

CONTENTS

Ready-Mix: *Get set before the cement flows.* P. 197

Black Widow: *Twin fangs inject the poison.* P. 106

Folk Toys: *Could you work a Flipperdinger?* P. 144

Monthly

America's Leading New-Idea Magazine for 88 Years

HOME AND SHOP

Wire Brushes for the Shop.....139
Make a Modern Magazine Rack....143
How to Build a Drawing Desk.....148
Materials File: Hardware (2).....153
Know-How File: Concrete Blocks..155
5 Steps to Tidier Painting.....158
Fix-It File: Garage Doors.....159
Saw-on-Wheels Rolls to Job.....162
Special Tear-Out Blueprint:
Ball-Turning Tool for a Lathe..165
Low-Cost Wrought-Iron Railing....173
For the Boat Owner.....174
Building a Film Dryer.....178
How to Make a Tripod Lamp.....181
A Desk-Drawer Postal Scale.....183
Getting Ready for Ready-Mix.....197
New Delta Radial Drill Press.....202
Two Chairs from One Shop.....205

AUTO UPKEEP

Hints from the Model Garage.....210
Gus Meets a Shifty Character.....214

SHORT CUTS AND TIPS

Improvised Leather Punch.....142
Clamp for Photo-Trim Board.....152
Board to Find Studs.....164
Trash Can on Wheels.....180
Grinding Bandsaw Guides.....184
Adjustable Workshop Lamp.....220

EVERY MONTH

PS Readers Talk Back..... 4
Have You Heard?..... 18
The Month in Science..... 23
Detroit Report..... 64
I'd Like to See Them Make..... 97
New Ideas from the Inventors.....101
Wordless Workshop.....150

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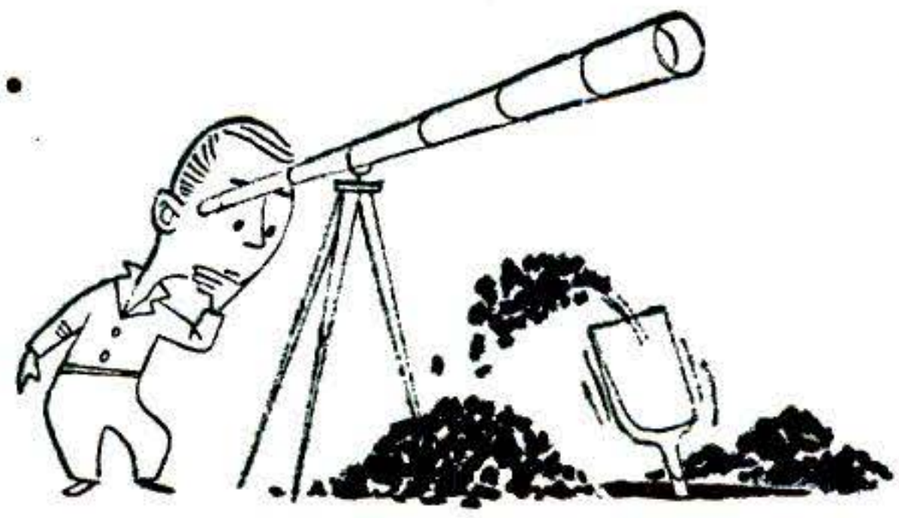


Likes That Look Inside the Earth

THOUGH I've seen other articles on the Moho project ["Hole to Probe Mysteries Inside the Earth," Nov.] and passed them up, I was attracted to your story because of the fine illustrations. After reading through it, I feel that I know a great deal more about what lies beneath my feet when I race for the corner bus in the morning. And—for the first time—I am as much interested in what lies beneath the earth's crust as I am in what is above it. Thanks to Mr. Armagnac for some fine reporting.

JAMES K. BURKE, San Diego.

The Doctors Applaud

THE forceful lead article in the December magazine ["If You're First on the Scene"] is a signal contribution to the traffic-accident problem. It should, in my opinion, be required reading for every person who holds a license to operate a motor vehicle.

This college has for many years been concerned with both preventive aspects of accidents and their improved medical management. Hence, articles of this character are especially welcome in light of their impact upon the public.

You and the author are to be commended for this worthwhile contribution to an important but poorly understood element of the traffic-accident problem.

PAUL R. HAWLEY, M.D.
Amer. College of Surgeons, Chicago.

PS Spurs 'Em On

I THOUGHT you'd be interested to learn that your article on new oil burners ["Small, Hot, Cheap," Nov.] has stirred up an unprecedented amount of interest and made a great impression on our industry.

One of the results will be to spur the overconservative manufacturers into developing and coming out with some new things themselves. This is good for the industry and the public.

RALPH T. HARTELL
Nat'l Fuel Oil Council, NYC.

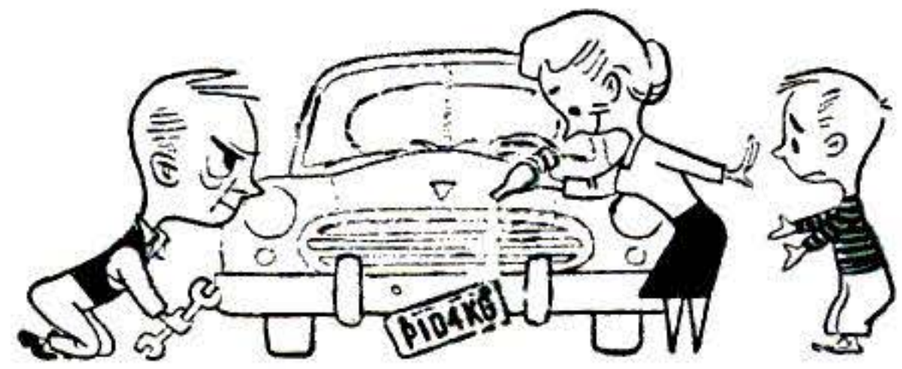
. . . POPULAR SCIENCE readers are always way ahead of others in hearing of things to come: that new oil burner, for instance. It will be a welcome development in home heating, but the oil industry is way off on a tangent when they consider going into air conditioners, clothes dryers, refrigerators, and other appliances. They'll never shift me from our essentially trouble-free electrical appliances.

But I would be "duck soup" for any salesman who approached me with a machine for my utility room that would get me 40 kilowatt hours out of a gallon of fuel oil. It would be a pleasure to tear out the heat ducts and hot-water pipes and then plaster electrical heating wires into the walls. And I'd probably burn more of their oil than I now do.

HAROLD H. WINTER, Newton, Ill.

Bubble Water Kills Rust

YOU covered about everything on "How to Loosen Rusted Parts" [Nov.], but you missed the easiest method—one well known for its effectiveness. Any carbon-



ated beverage applied to rusted parts can loosen them within two minutes. I've used this dodge many times and know that it works. This practice originally called for the use of "coke," but any carbonated beverage will serve as well.

One nice feature, of course, is that as soon as the rusted parts are separated,

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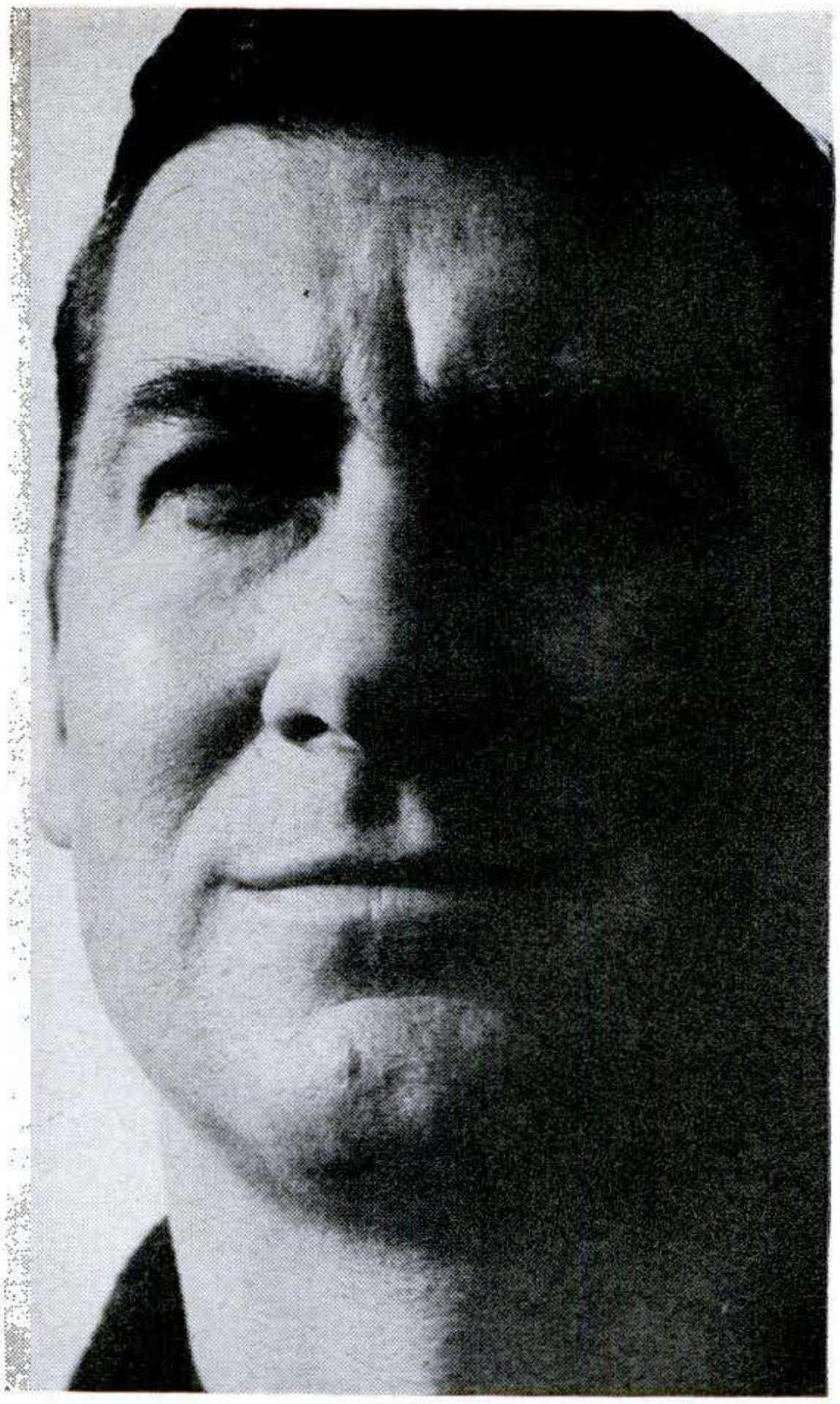

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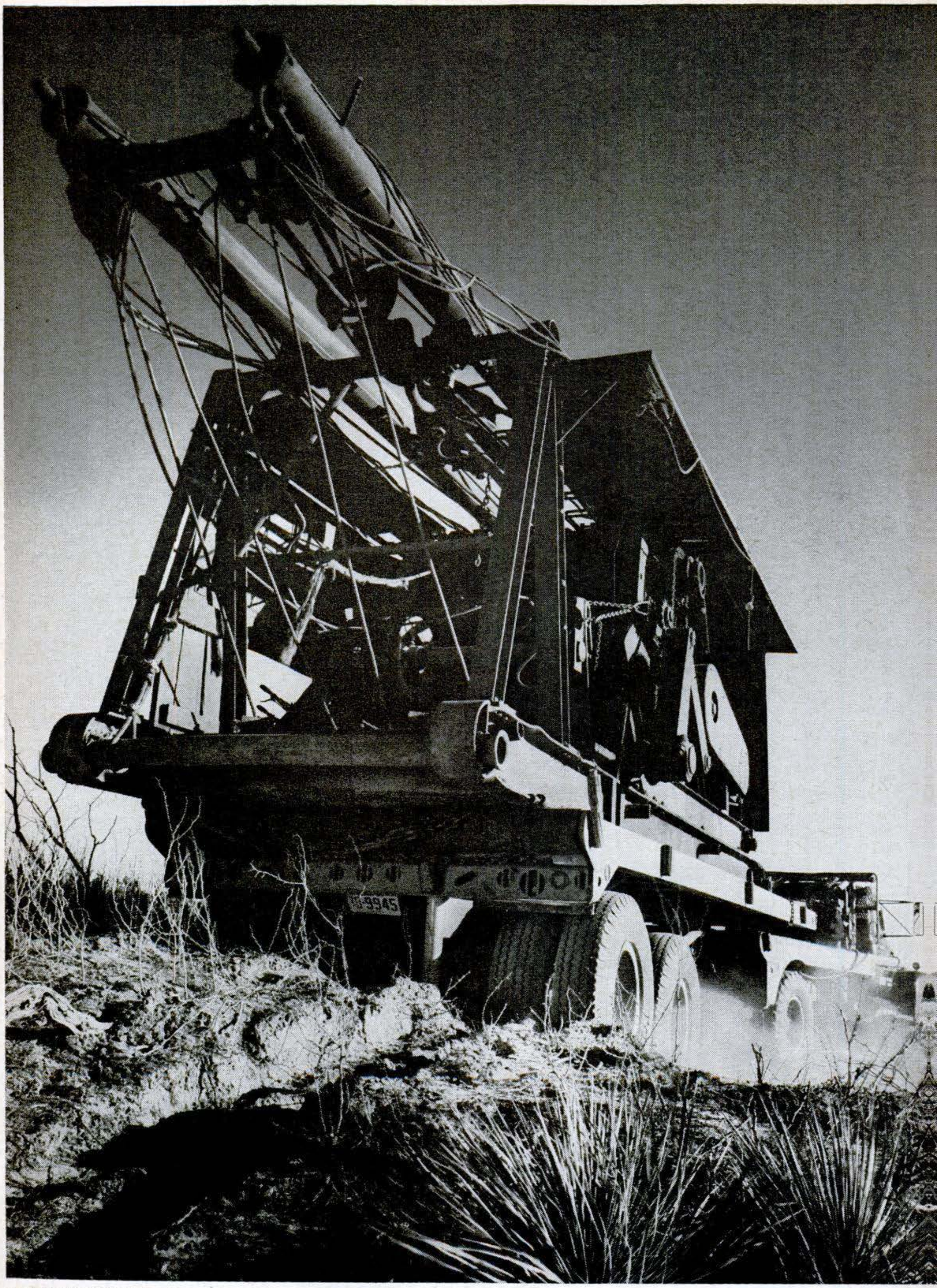

OIL RIG HAULER: Roy Fox, Odessa, Texas. "Firestone Steelcords take haul-trails that eat up other tires"

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Here's owner proof of Firestone truck tire performance!

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BULK OIL HAULER: Ted Kurk, Cheektowaga, N.Y. "Firestone tires keep all my deliveries on schedule in the city and upstate both."

WHOLESALE MEAT TRUCKER: Peter Smith, St. Clair Shores, Mich. "Tire maintenance dropped 90% with Firestones. I'll buy nothing else!"

Transport* | Super Mileage Lug* | Super All Traction* | Rib Excavator* | Rock Grip Excavator* | All Traction*

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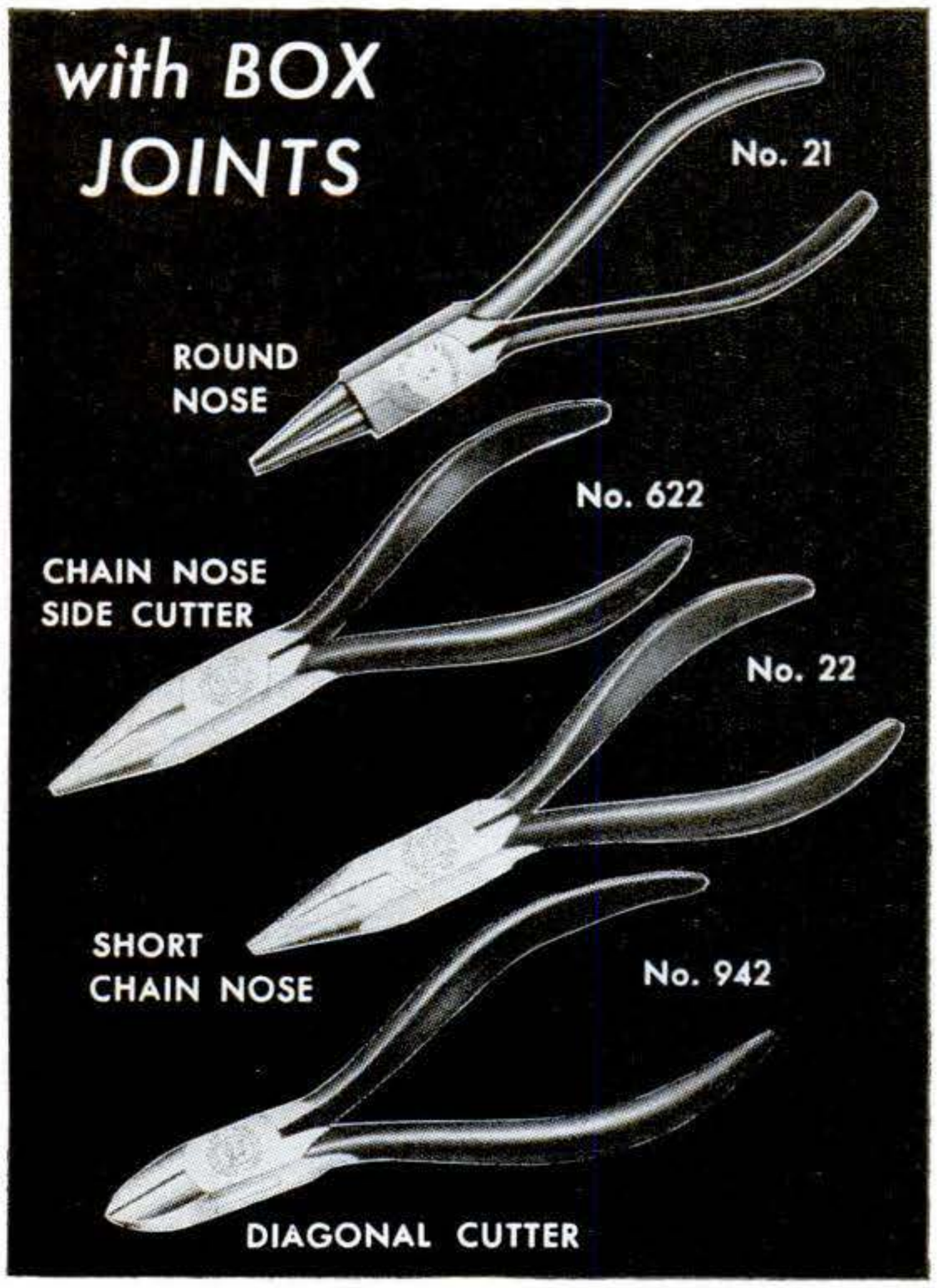

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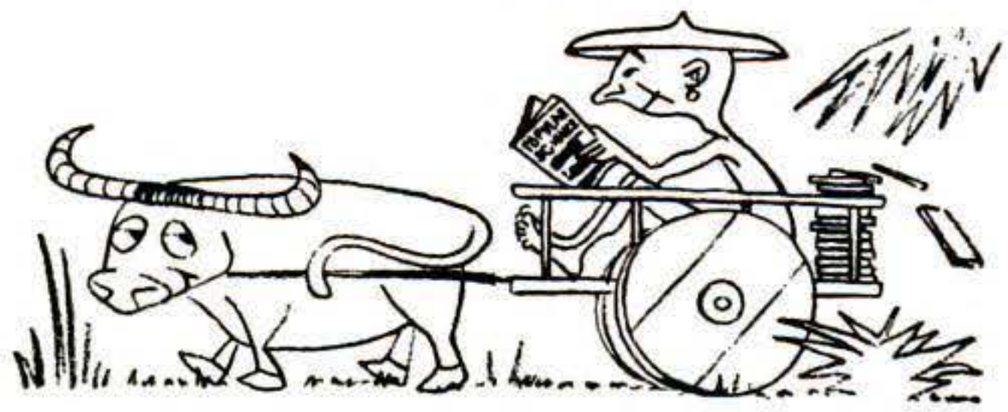
the balance of the beverage can provide some refreshment.

J. H. GARRAGHAN, Windham, N. Y.

How to Make Friends for America

MY WIFE and I are engaged in a "Magazines for Asia" project. Thousands of letters requesting magazines are received each month from Ceylon, Indonesia, Ma-



laya, Burma, and other S.E. Asia countries. Yours is one of the most asked-for magazines.

Perhaps some of your readers would be willing to send on their discarded copies and thus help to further international understanding and good will. If they will send a stamped return envelope to me (at 2444 Silver Ridge Ave.), we'll send back an actual request from Asia, together with a mailing-instruction sheet.

HENRY MAYERS, Los Angeles.

All Karts Aren't Go-Karts

YOUR article on one-lung race cars ["Go-Karts Make Auto Racing a Family Sport," Dec.] indicates that you are unfamiliar with the correct terminology for these fascinating new motor vehicles. The recognized name for most cars of this nature is "kart." The recognized name for the sport is "karting."

The term "Go-Kart" is not such a generic term, but is a trade mark and refers only to the karts manufactured by us.

FRANK S. LIVINGSTONE, Pres.
Go Kart Mfg. Co., Inc., Azusa, Cal.

What Makes Horse Races

ON THOSE nine "not so good" points about the Corvair [Oct.]: Except for point 4—the center gearshift-lever location—I feel, as a Corvair owner, that all the other supposed disadvantages are pure bunk.

1) We notice no oversteering. 2) The pedals are easy to reach. 3) Tire pressures have not worried me yet. 5) You do not have to learn to drive this car. 6) Why worry about the valve covers? Tappets are hydraulic. 7) That rear window

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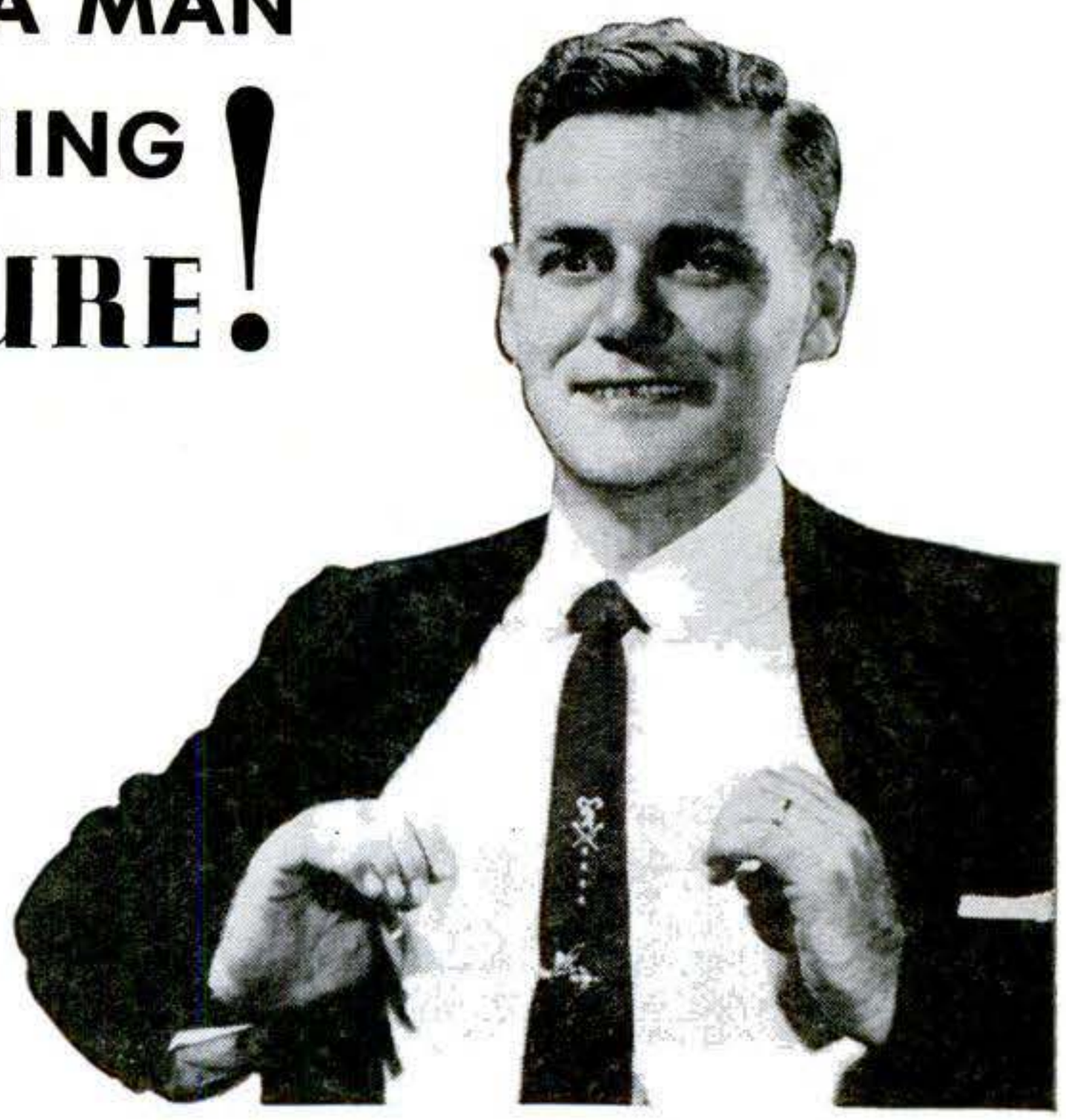
WHAT HAPPENS WHEN A MAN DECIDES TO DO SOMETHING ABOUT HIS FUTURE!



The proven rule of "learn more to earn more" took M.E.F. (name on request) from a position of truck driver to that of an accounting executive in sixteen months. Listen to what M.E.F. says:

"I was driving a truck—working long hours and not making much money. I had a burning desire to better myself in life, and decided to enroll with LaSalle. I went along driving my truck days and studying nights and got my first break after completing 35 assignments. I took a cost accounting position. Within one month after starting full-time, I received my first raise, thereafter followed more. One of the greatest thrills of my life came just nineteen months after I started with LaSalle. When our firm opened up a branch office, I was assigned to take charge of the Accounting Department and my salary has doubled."

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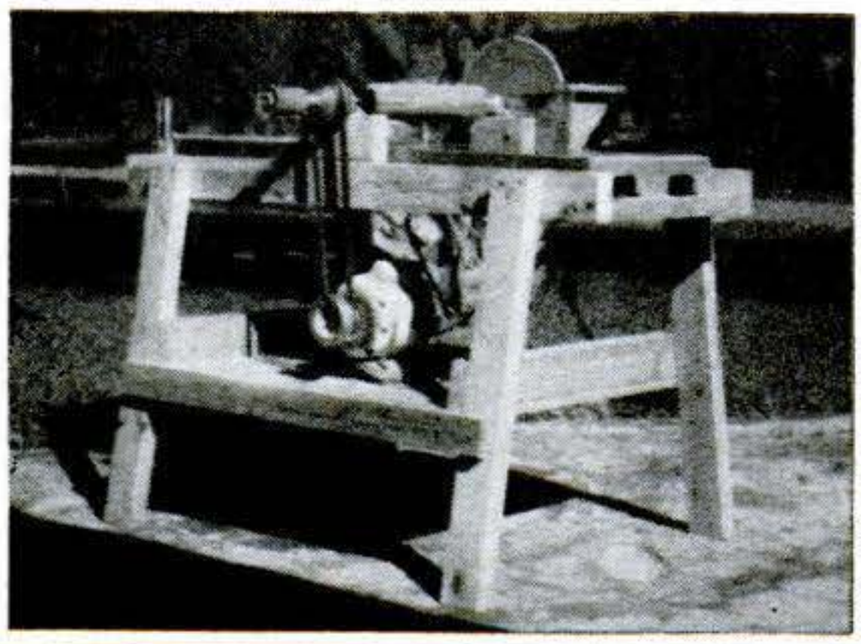
is more modern than the Falcon's. 8) Time will tell about the fan belt, but I do carry a spare. 9) With 4½ cu. ft. of rear storage space, why would anyone want to pile things up?

FAY O. WOOD, Elkhart, Ind.

Have you read what we said about it in our January issue after driving it 10,000 miles in one month? Several of us here are plain nutty about the Corvair.

Sander Plans Please Him

I THOUGHT you might be interested in seeing how the woodworking tool designed by Mr. De Cristoforo ["A Thickness Sander for Home Shops," Oct.]



turned out for one reader. With only a few minor changes to fit my material, I followed his plan. The tool works fine.

K. P. FLAGG, St. Augustine, Fla.

First Aid for Rolling Mills

I READ about Mr. Conkovich's troubles in a rolling mill ["Centering Rolling-Mill Coils with a Shadow," Dec.]. He might like to know that we make an automatic pilot for flyers and the problem of maintaining a plane in straight and level flight requires accuracy greater than that for rolling metal.

Mr. Conkovich could place one of our sensors on his rolling mill. He could then control the location of this part to within plus or minus .001 of an inch. If this accuracy is too great, it could be reduced by changing the sensitivity control of the amplifier.

D. H. MITCHELL, Pres.
Mitchell Industries, Inc.
Mineral Wells, Tex.

It's Old Stuff in Germany

I WAS interested to read that mirrors are being installed at blind crossings in

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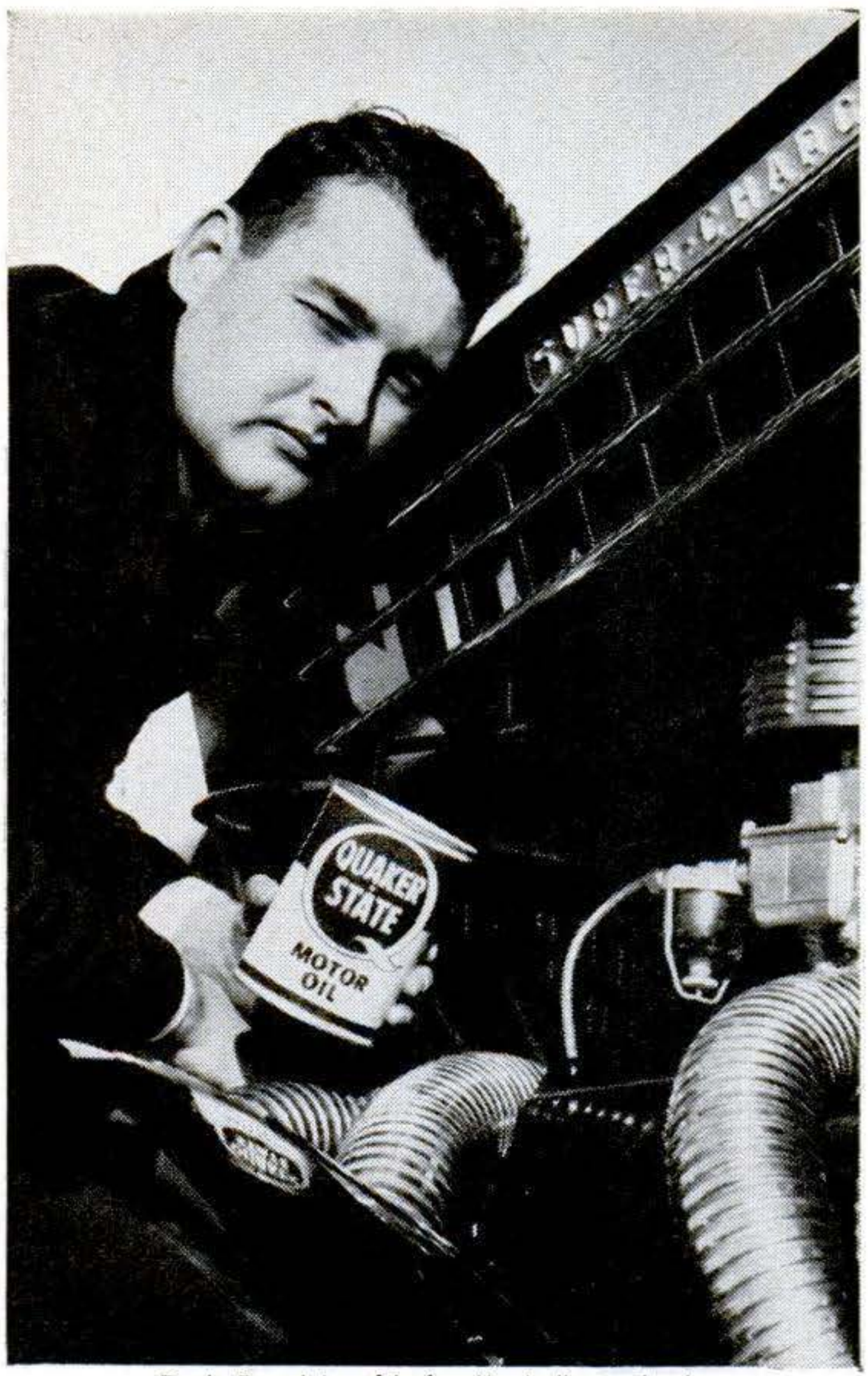

Denis Drysdale, of Lafayette, Indiana, checks the engine of his classic Auburn cabriolet.

"Quaker State keeps the engine of my classic 1936 Auburn trouble-free, and my new car too!" This Series 852 beauty boasts a 150 hp. straight 8 engine, big for its day, and dual rear axle ratios. Performance is still superb, thanks to the loving care it has always received. Important item in that care: Quaker State Motor Oil. Its long-lasting protection and complete lubrication guard any car best, new or old! Super-refined from 100% pure Pennsylvania crude oil. It's the finest motor oil your money can buy.

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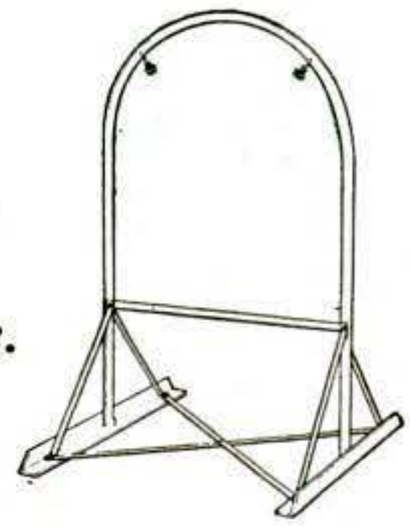

QUAKER STATE OIL REFINING CORP., OIL CITY, PA.
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South Africa ["PS Readers Talk Back," Dec.]. Such mirrors have been in use for many years in Germany and seem to be very successful. To cover an area as large as possible, they are shaped like a searchlight mirror but with the reflecting surface on the outer convex surface. Surprisingly, they last for many years under all kinds of weather conditions.

PETE KENT, New Providence, N. J.

He Foils Florida Sun

POSSIBLY my troubles with a remote-control system for garage doors might be helpful to other PS readers. I put two electric eyes at the garage door and two spotlights on the car, one for opening and one for closing the door. Shaded by trees, they worked fine in Virginia. When I tried the same thing in Florida, the bright sun often opened or closed the

door and I had to abandon the photocell system.

I then buried a waterproof mercury switch in the driveway in the hollow of a cement block. To trip the switch, I made a coil—a 1¼"-by-3" core wound with three pounds of No. 16 enameled wire—to go under the car. At six volts, this takes about 10 amps. To save the contacts on the dash pushbutton, I used a horn relay. When I got a new car with 12 volts, I rewound the car coil with 2½ pounds of No. 19 wire. No horn relay was required. To waterproof the coil, I soaked it in asphalt roofing paint. As a precaution, I installed a switch in the garage floor. When the car is in the garage, its front wheel is on the switch and all outside controls are disconnected.

J. G. MENUT, New Smyrna Beach, Fla.

Back in the Old Days . . .

READING about the hydroponic method of growing fresh grass daily for winter cattle feeding ["Picture News," Nov.] sure brought back memories for me.

About 40 years ago, my dad set my

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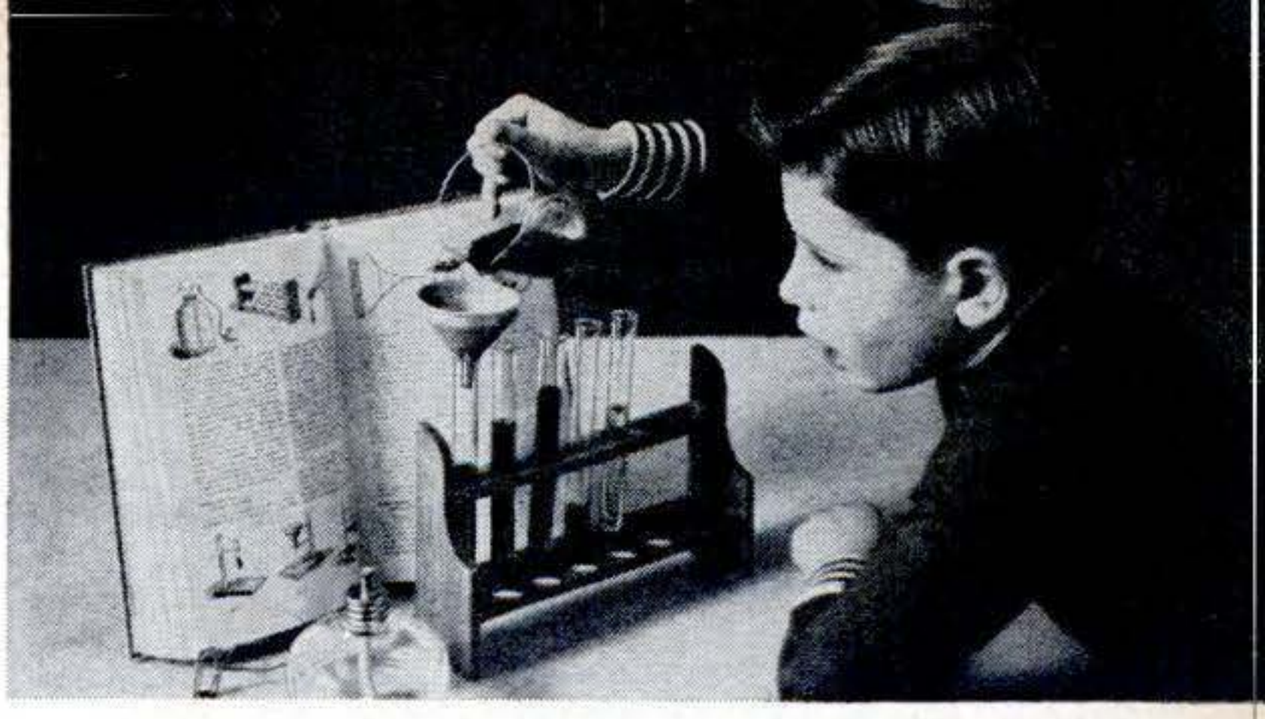

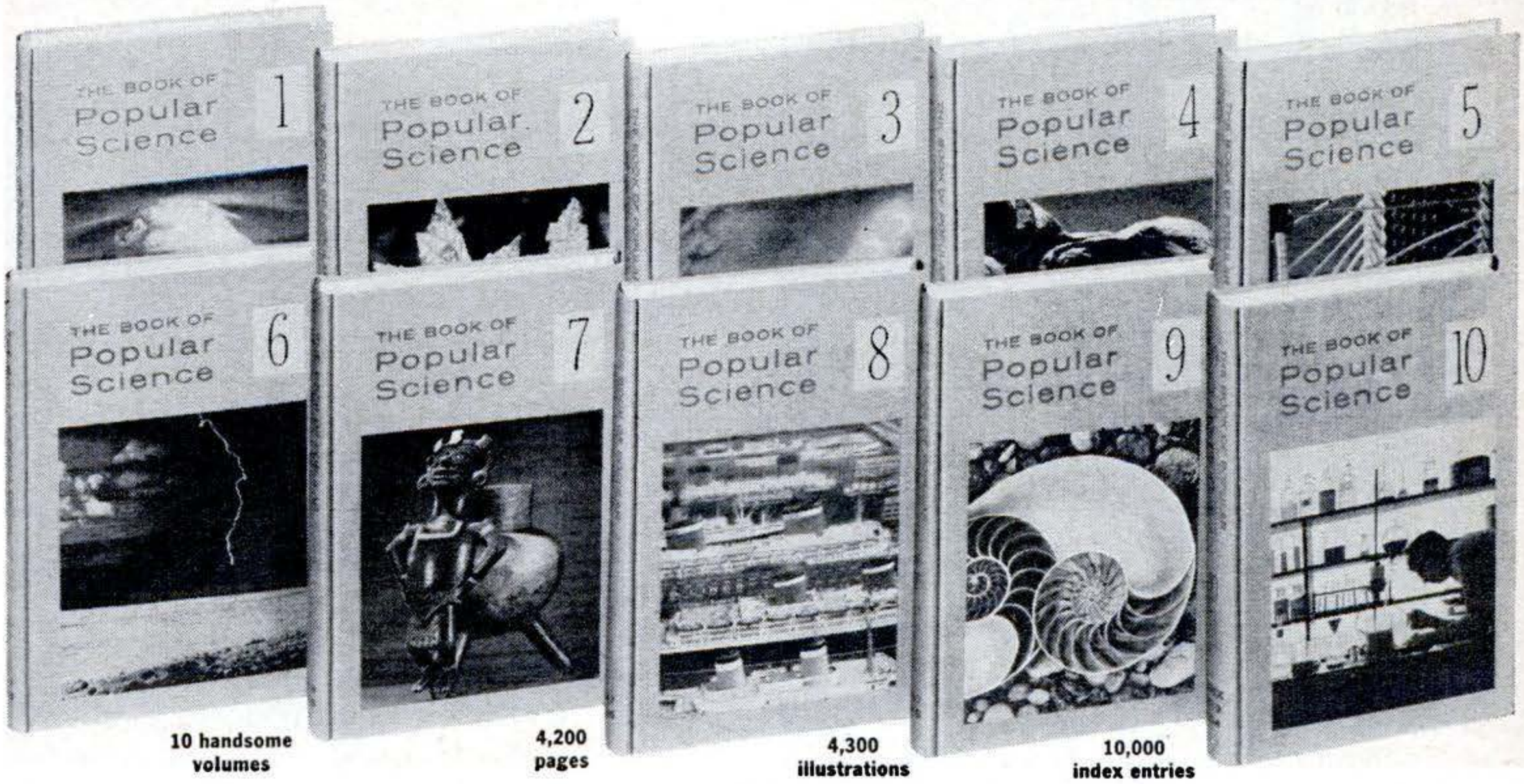

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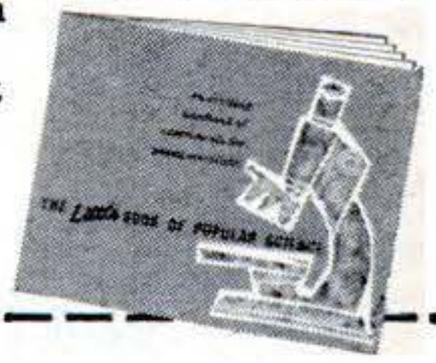

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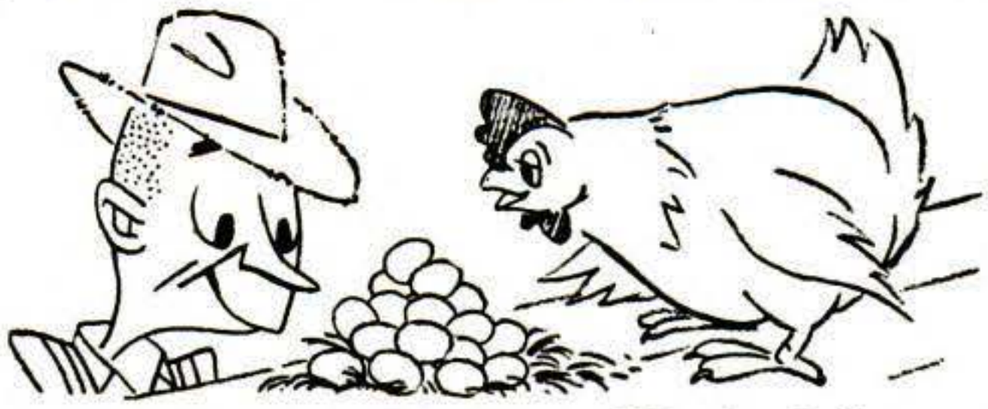
older brother and myself to work providing fresh greens daily during the winter. We soaked grain oats in water overnight, then placed this in trays covered with burlap which was kept damp for two days. After removal of the burlap, the plants were watered and allowed to grow to a height of three or four inches for



feeding to the chickens. We had lots of good fresh eggs all winter.

T. H. GLASS, Struthers, Ohio.

Tip-Swappers Still Swapping

I HAVE a very simple way of locking in house screens and cellar storm sash.

I drill a hole through the edge of the sash into the sill and drop a nail in. This does away with hooks and eyes and is neater than screws. You can lift out the nail with a pry or pliers.

I also eliminate unsightly hangers on screens by driving nails into the upper edge of the sash and drilling matching holes in the casing. I cut off the nail heads after driving them. You can reverse the procedure—nails in the casing, holes in the sash.

ERNEST HEINO, Seattle.

The Courtly South?

SO THE AAA suggests pairing parking meters in 18-foot spaces with an eight-foot oasis between pairs ["Have you Heard?" Dec.]. Cars parked in pairs, bumper to bumper, would have eight feet of space before one and behind the other for maneuvering. So what?

In the conventional method, the 18-foot car centered in a 22-foot space leaves two feet before and behind it. Adding the extra two feet of adjacent parking spots, what have you? Four feet before and four behind, or eight feet.

Let's not kid ourselves. You can't make more parking space by merely drawing some lines along the curb.

EARL ALLGAIER, Arlington, Va.

Right—if the drivers in your town always center their cars, and you're never locked in.

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it can drill through hard bends and switchbacks as adroitly as many top-rated sports cars,"

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According to "Uncle Tom," the Commando power plant ". . . can whizz out 0-60 mph in 8.2 seconds."

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Wanted: A Dump for "Hot" Garbage

THERE are already 70,000,000 gallons—a substantial lake-full—of ominous liquids corked up in a couple of hundred huge steel tanks at Savannah River, S.C., Arco, Idaho, and Hanford, Wash. The tanks are underground. Their contents are the most dangerous of the radioactive leftovers from atomic-energy operations. Some of them are so "hot" radioactively that they are hot thermally, and have to be specially cooled to keep them from boiling.

By the year 2000, there'll be 30 or 40 times as much. The specter of man pushed off the earth by wastes from the atomic age haunts many scientists.

Disposing of atomic garbage is so difficult because, unlike ordinary trash, it does not always decay into harmless dust quickly. Some atomic wastes keep pouring out deadly radiations—which can't be seen, felt, smelled or tasted—for thousands of years. They might harm people directly, or contaminate food or pollute water for a long time before anybody noticed what was happening.

Dilute and disperse. At present, "low-level" liquid wastes, containing little radioactivity, are sealed in concrete-lined containers and dumped at sea. There are two official dumping grounds, both deep, one 120 miles off New Jersey and the other 60 miles out of San Francisco. If the stuff eventually leaks out, the ocean will dilute it safely.

Gas wastes are filtered, then passed out of a high stack to be dispersed by the atmosphere. To insure safety, the AEC and other government agencies carefully check air currents nearby.

Concentrate and contain. The very dangerous high-level liquids are now concentrated as much as possible, and then just stored in tanks. This is expensive, and can't go on forever, so the AEC is testing alternatives:

- Converting the liquids into inert solids (oxides or clays) which could be buried.
- Pumping the wastes directly into underground rock formations from which they couldn't leak.

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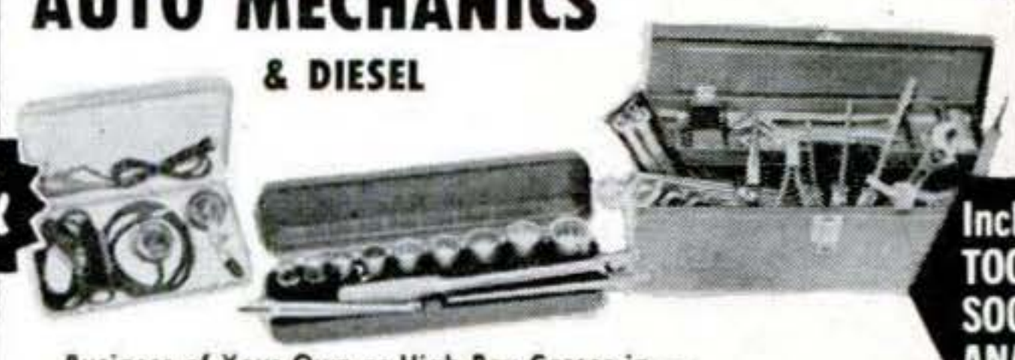

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...have you heard...?

Are outboards a cinch to steal? Apparently. Insurers say that theft costs them more than any other type of outboard-motorboat claim, except carelessness. Check your policy to see how you're covered. Or, if you're a new buyer, consider the choices of insurance available.

Outboard-motorboat policies are generally "all-risk." They cover wind and weather claims, collision, damage to boat or trailer in transit, theft, vandalism, etc. They differ from the "limited-peril" contracts written for inboards or yachts, and allow you to use the boat in all waters at all times.

But read the small print. Are you protected against contingencies such as:

- Theft of accessories other than the motor?
- Use of the boat in races? Or when rented to others?
- Personal liability? (Generally not included, on the assumption that your general insurance covers this.)

For a $1,000 boat you may pay anywhere from $20 to $60 a year, pretty much writing your own ticket. You pay so much per $100 of insurance, depending on how much of the loss—up to $100—you yourself are responsible for. Rates have gone up along with boat popularity. Insurers are getting fussy about whom and what they'll insure, carping at the growing number of careless Sunday skippers. (One cites the case of submerged motors. Careless boaters neglect to wash them out with fresh water and pour oil into the cylinders, figuring maximum salt-water damage has already been done. It hasn't.)

Most contracts are for one year, but can be extended at lower rates.

Starve moths to death. Insecticides that used to kill bugs only whet the appetites of today's immune wool-eaters. So University of California scientist Roy Pence proposes treating cloth with chemicals that look—maybe even taste—like food to moths or beetles. The catch is that they throw the bug's metabolism out of whack. They prevent the use of vitamins essential for growth.

The process kills the bugs before they reach adult stage. The larva, freed from its egg, grazes around the cloth looking

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Uncomfortable waterproof clothing is easy to get—as any slicker-wearing sailor can tell you. The problem the Army claims to have licked is how to make the more comfortable porous fabrics permanently wetproof. The Army describes its secret as a combination of "a pyridinium-type repellent with a fluorocarbon."

What, Ma, no licorice? Candy is dandy but (maybe) not when it's black, say officials of the Food and Drug Administration. They're asking manufacturers of carbon-black coloring to show that its presence in jelly beans, licorice, and other such goodies is perfectly safe.

New amendments to the pure food and drug laws go into effect this month. They require all makers of food additives to prove their ingredients harmless before they can be put into food.

If you travel off-season, you'll be able to buy your ocean trips at a discount this year. For the first time in 20 years the 26 transatlantic steamship lines are offering a 10-percent reduction on round-trip tickets, provided you avoid the summer "high" season.

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If you sail on one of the bigger liners, say the United States or one of the Queens, the "high" season minimum tourist rate is $222 one way. If you go off-season, you normally pay about 12 percent less. The one-way fare comes to $195.50. But the extra slice that the round-trip discount removes brings the rate down to $176 each way—21 percent off the original fare.

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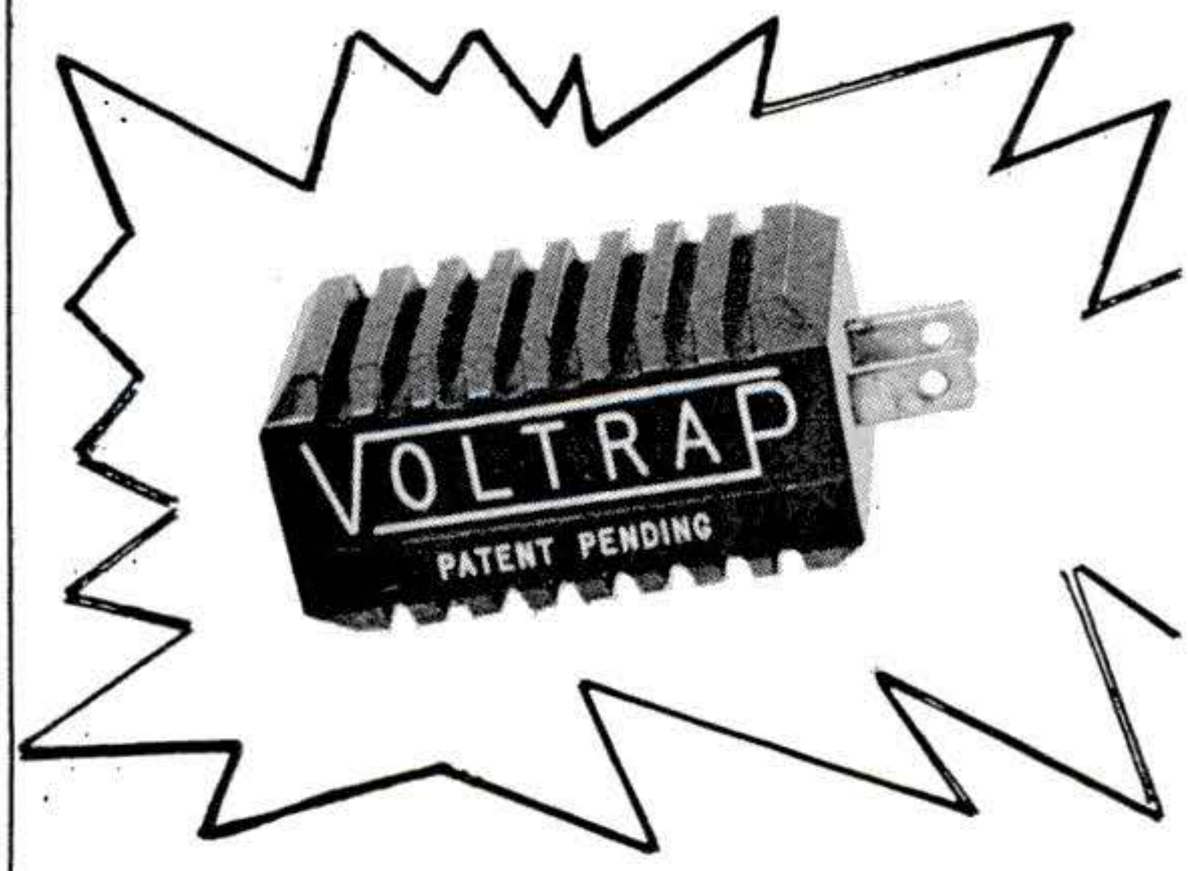

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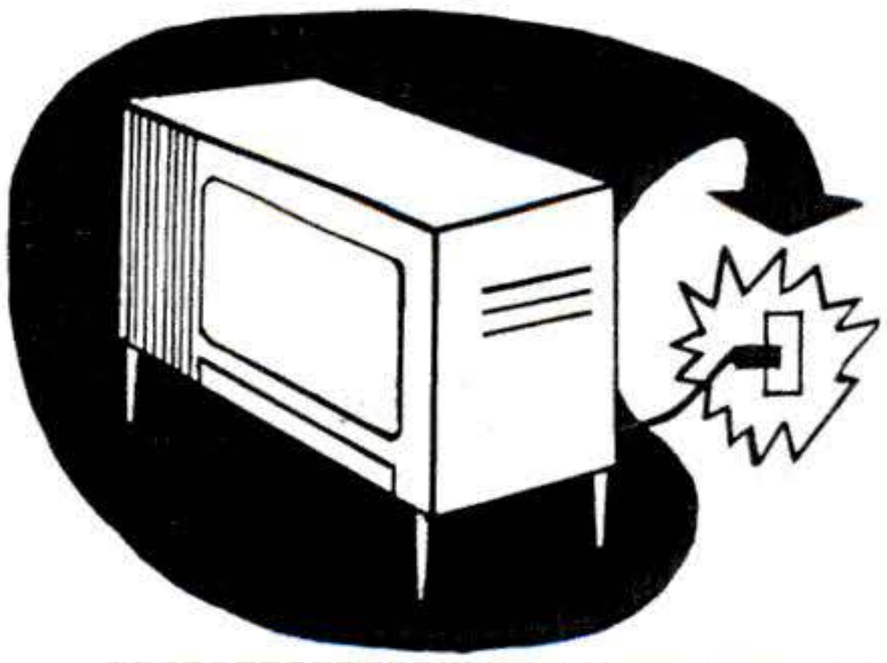

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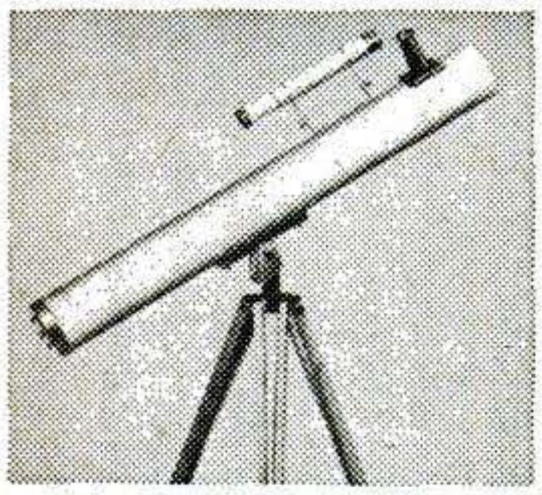

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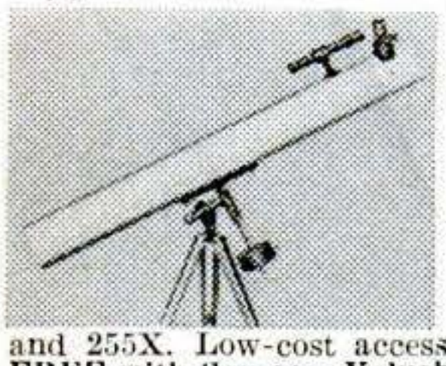

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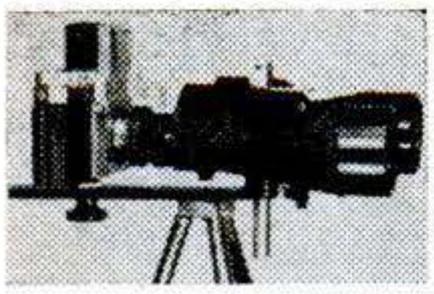

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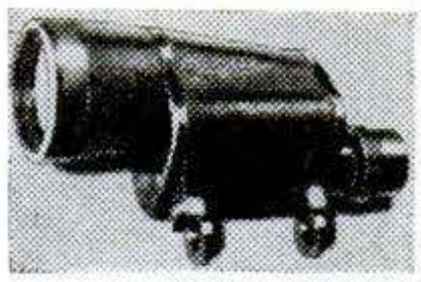

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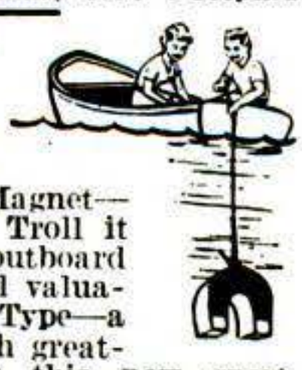

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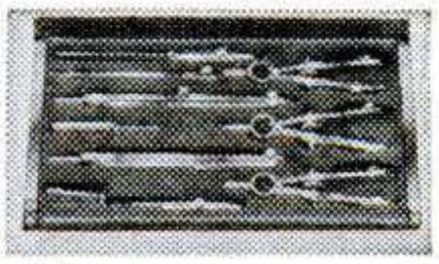

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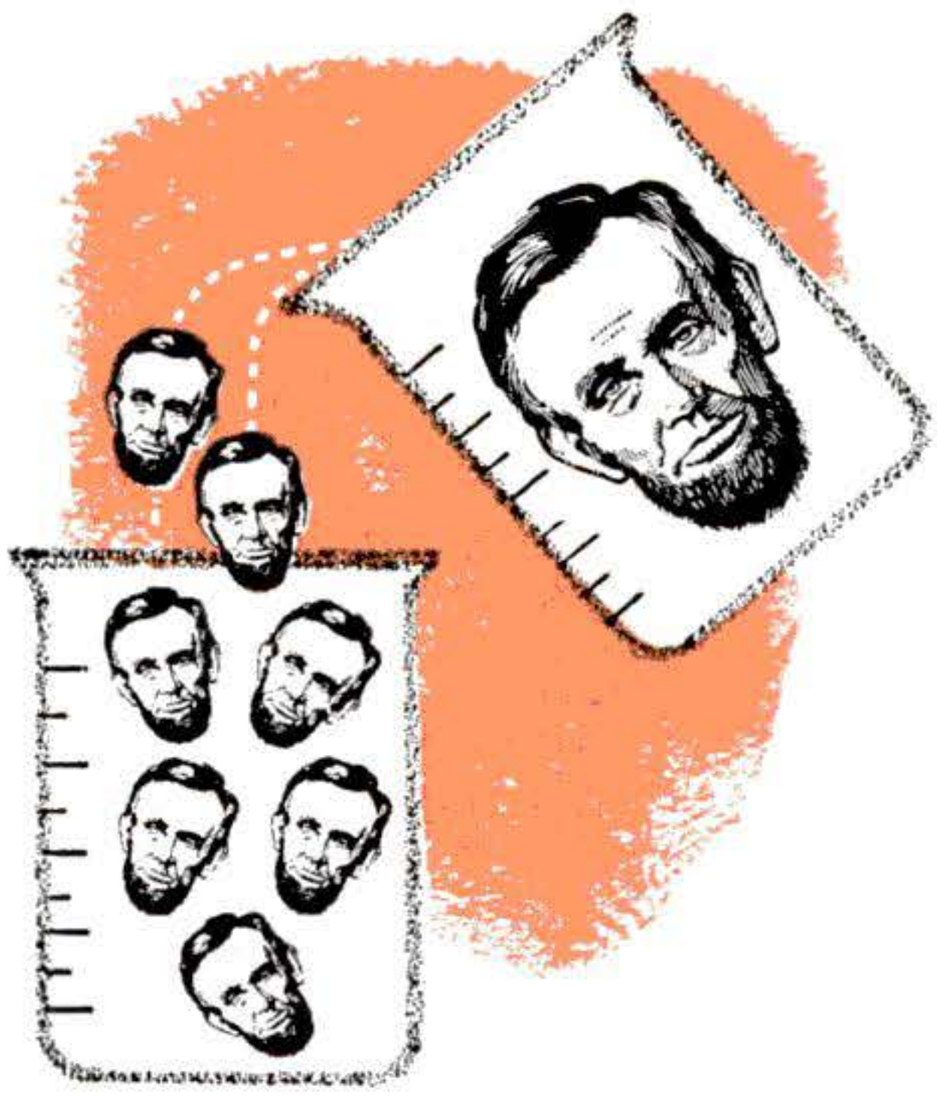
The month in science

How to breed supermen. The world would certainly be a better place if our great men—the Lincolns, Einsteins, da Vincis—could be made to reappear every few generations. Fantastically, that now seems possible, according to the world's foremost expert on heredity: Indiana University's blunt-spoken Hermann J. Muller.



The dead cannot be exhumed and revitalized, but "carbon copies" of future geniuses could be preserved for birth and rearing as needed. The newborn baby, destined for greatness, would be as like his famous predecessor as an identical twin—even though he were born to parents totally unrelated to the original and years after the original had died.

This startling idea is only one of several radical proposals by Muller. He sees the human race slowly but surely going to the dogs (or worse). Medical science now saves the lives of people whose heredity is defective (a laudable achievement), and enables them to have children, passing their defective heredity on to future generations (not laudable at all). The defects will pile up and spread throughout the entire population of the world, until eventually (millions of years) mankind deteriorates hopelessly. Long before then, it would become simpler to junk the human race in favor of robots.

Muller is not content with braking this slide to extinction. He wants to upgrade the tired old human race into a world-wide family of paragons—upright, loyal, tolerant, kindly, and very, very smart—spiced with a sprinkling of carbon-copy geniuses.

Physical improvement is needed, too. Muller mentions only one I'd-Like-to-See-Them-Make (for fear of being kidded), but it's a dilly: a third eye that works in reverse. Instead of creating mental images from objects, as present eyes do, it would display thoughts as pictures on a tiny TV-like screen. You wouldn't have to fumble for words to describe a machine, for example; you'd just imagine the machine and open your third eye to let people see it!

All this could be created with techniques from plant and livestock breeding (assuming people got over the vain notion that their children should resemble them, and sought the finest heredity available for their offspring). Muller tells how:

- Artificial insemination—fertilizing the mother's egg with seed from a selected male, not her husband—is a routine medical procedure. Thousands of babies have been begotten this way (although their legal status is often in doubt).
- Transplanting an egg from one woman to the womb of another provides the female counterpart of artificial insemination. It

CONTINUED

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hasn't been done yet, but requires only a little more research, according to Muller. The egg could be fertilized artificially during transplantation, to control both halves of the child's heredity—he would be no "blood relative" of either the woman who bore him or her husband.

- Parthenogenesis—nonsexual reproduction—would make carbon copies of people. The technique, already tried on frogs, is delicate. The nuclei of the heredity cells are deftly cut out of a fertilized egg and replaced with nuclei of cells (not sperm) from a selected individual. The remodeled egg is then implanted in the new mother's womb to grow. This method is essentially the one that nurserymen use for propagating apple trees. "Cuttings" from a great man would mature into adults just like him—no resemblance to any mother (except the great man's mother).

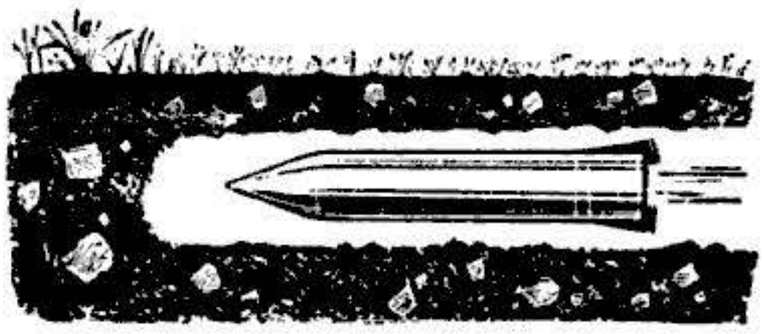
These schemes, while complicated, are very efficient and probably acceptable to many people. The raw materials for reproduction—eggs, sperm, cells—could be frozen, stored indefinitely, shipped anywhere. A little goes a long way—a few outstanding men and women could furnish genetic stock for thousands of babies. And there is no upsetting established sex practices. People would still mate as they chose, while ordering their children custom-made.

How many gigas in a tera? Do a thousand picos equal one nano? Mathematicians are on the loose—dropping zeros, coining words. The reason? The endless chains of zeros that today's ultra-precise scientific measurements continually spawn. The solution? New prefixes, recommended by the International Committee on Weights and Measures at its 1958 meeting in Paris, and recently adopted by the U.S. Bureau of Standards. "Tera-" is now the biggest—it means a trillion (10 terameters would be 10 trillion meters). "Giga-" is a mere billion. At the small end of things little "nano-" has been added and means a billionth; littler "pico," a trillionth. (Yes, a thousand picos equal one nano.) The complete list of prefixes is shown at left.

THE VERY LARGE	
tera-	1,000,000,000,000
giga-	1,000,000,000
mega-	1,000,000
kilo-	1,000
hecto-	100
deka-	10
THE VERY SMALL	
deci-	0.1
centi-	0.01
milli-	0.001
micro-	0.000001
nano-	0.000000001
pico-	0.000000000001

Of course mathematicians do have a word for a very big number—it's a "googol." The name was the invention of the nine-year-old nephew of mathematician Edward Kasner who first described it. A googol is the number 1 followed by 100 zeros.

Underground rocket. The Russians are using a weird inside-the-earth rocket to burn subterranean tubes (for irrigation water) out of the soil. The U. S. Central Intelligence Agency says the gadget looks like an artillery shell with a flaming jet at the head. The flame fuses the soil to leave a large, sturdy "pipe."



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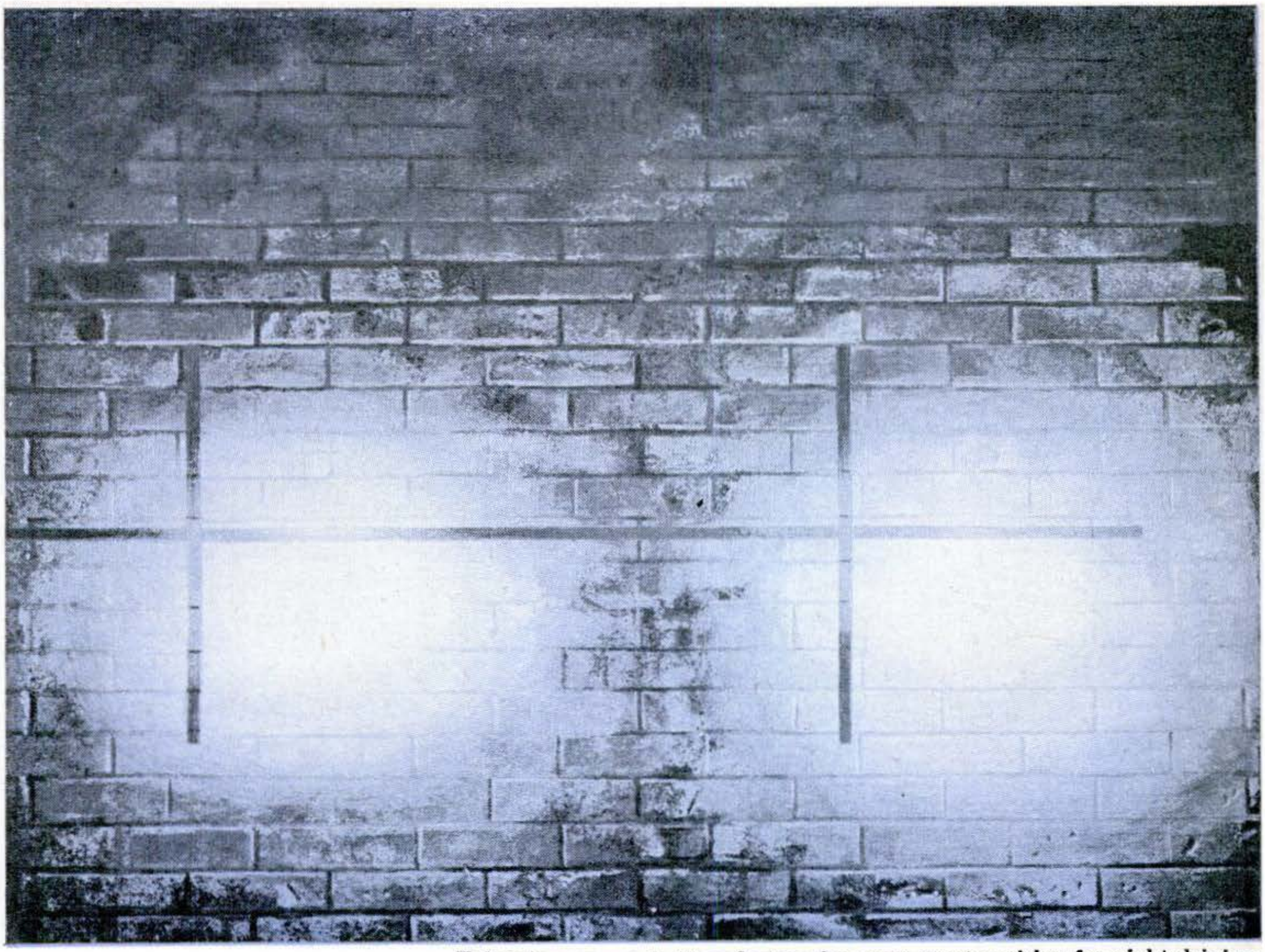

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THE 1960 FORD Falcon

FORD DIVISION, Ford Motor Company

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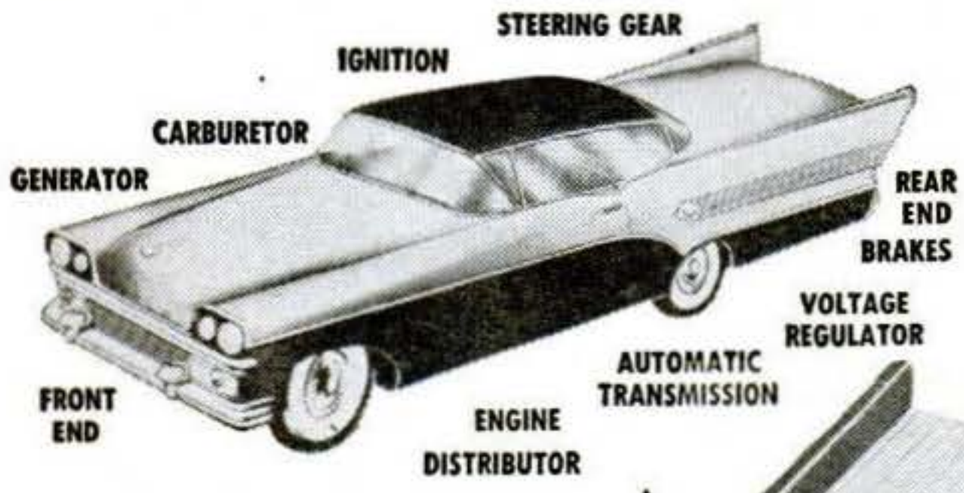

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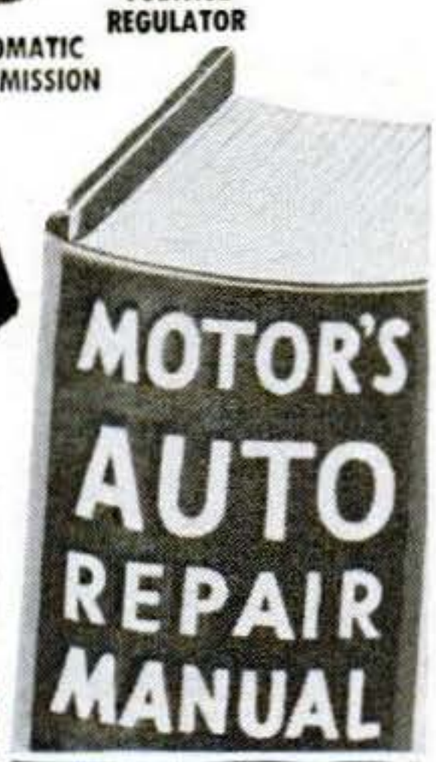

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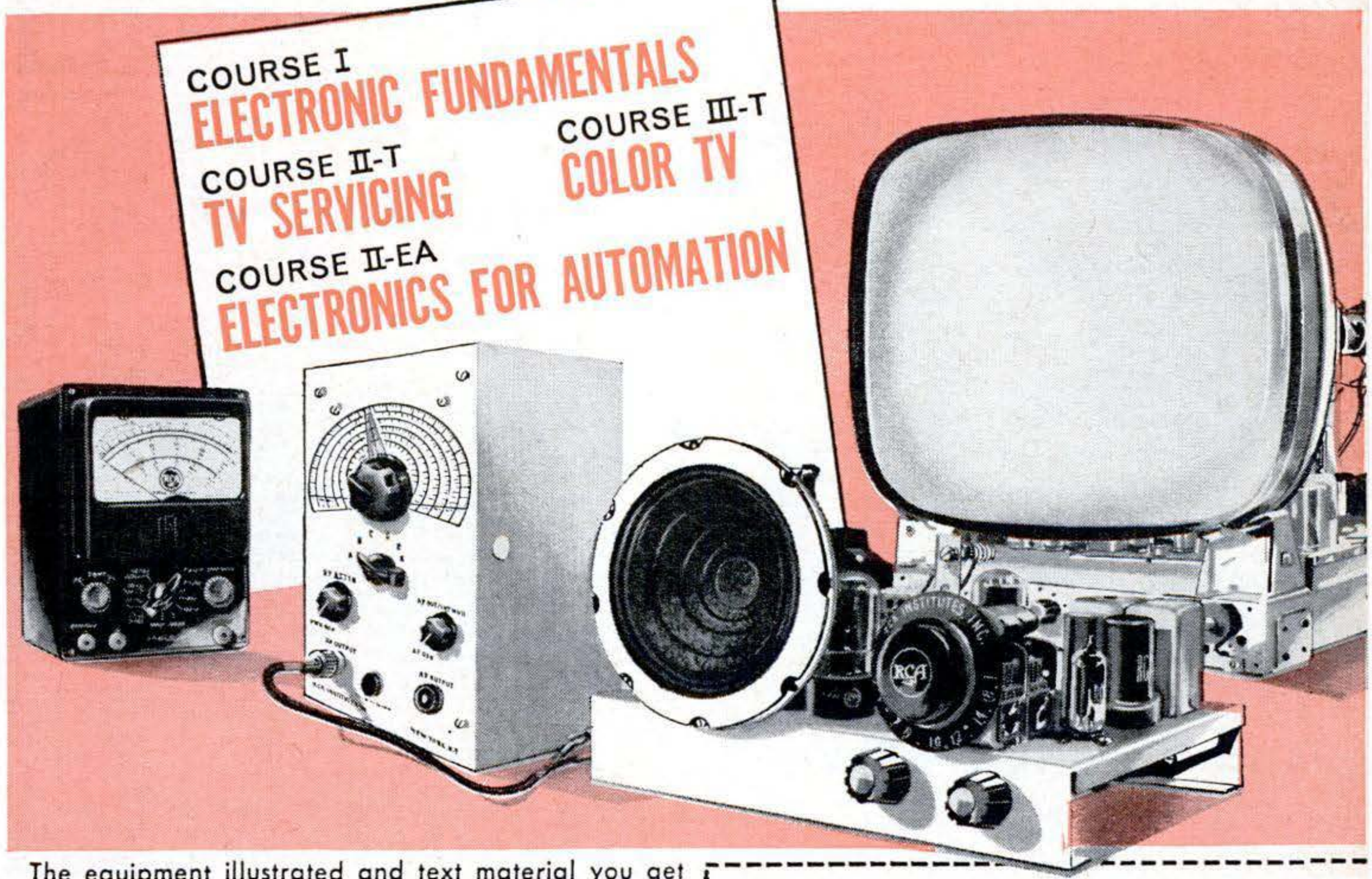

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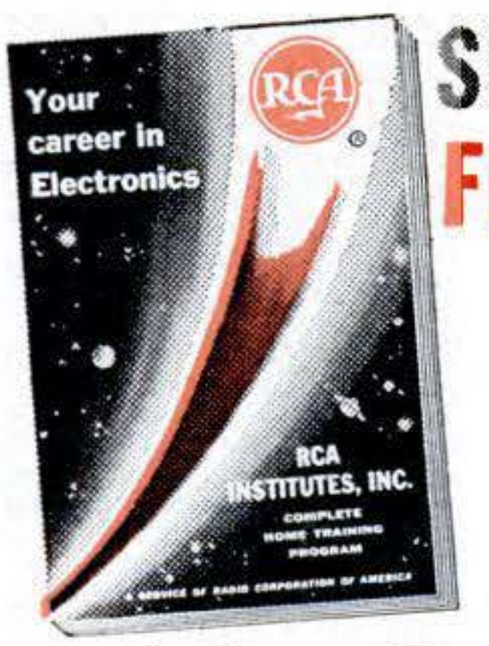

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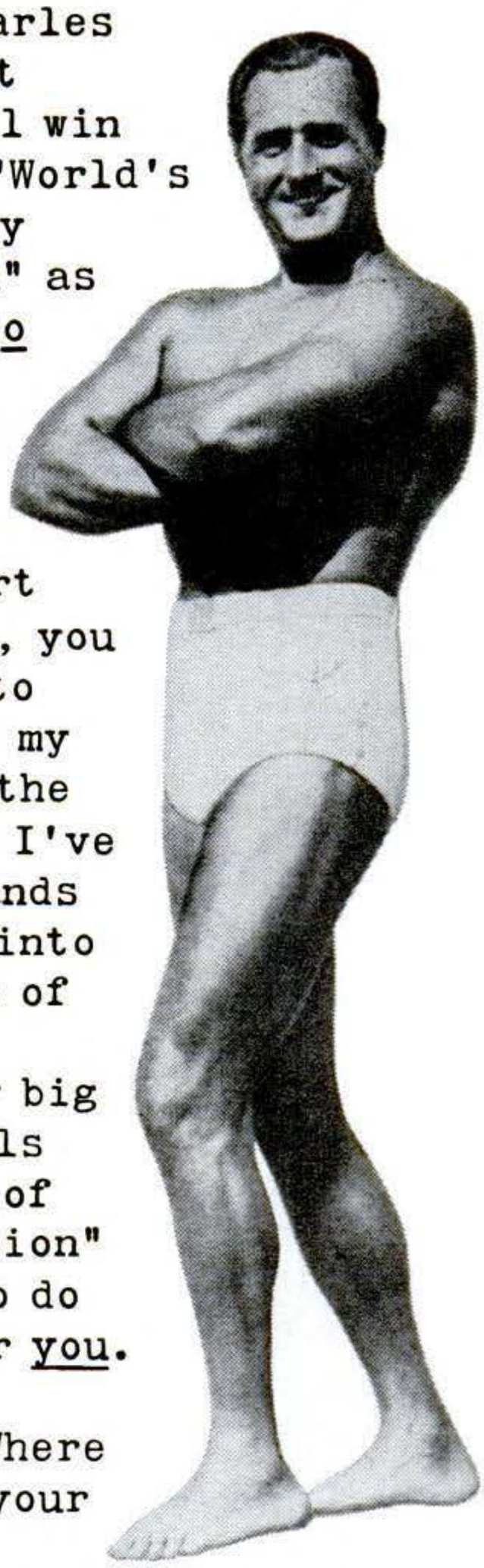

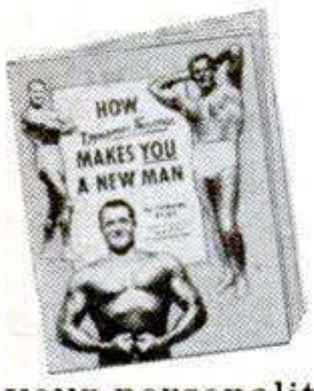

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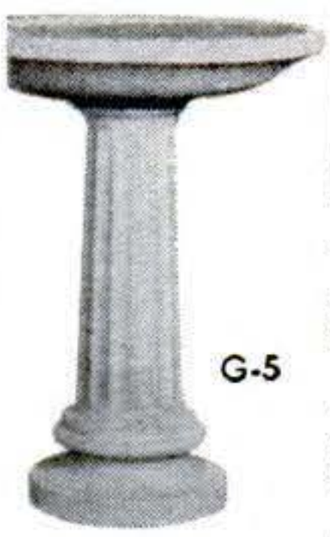

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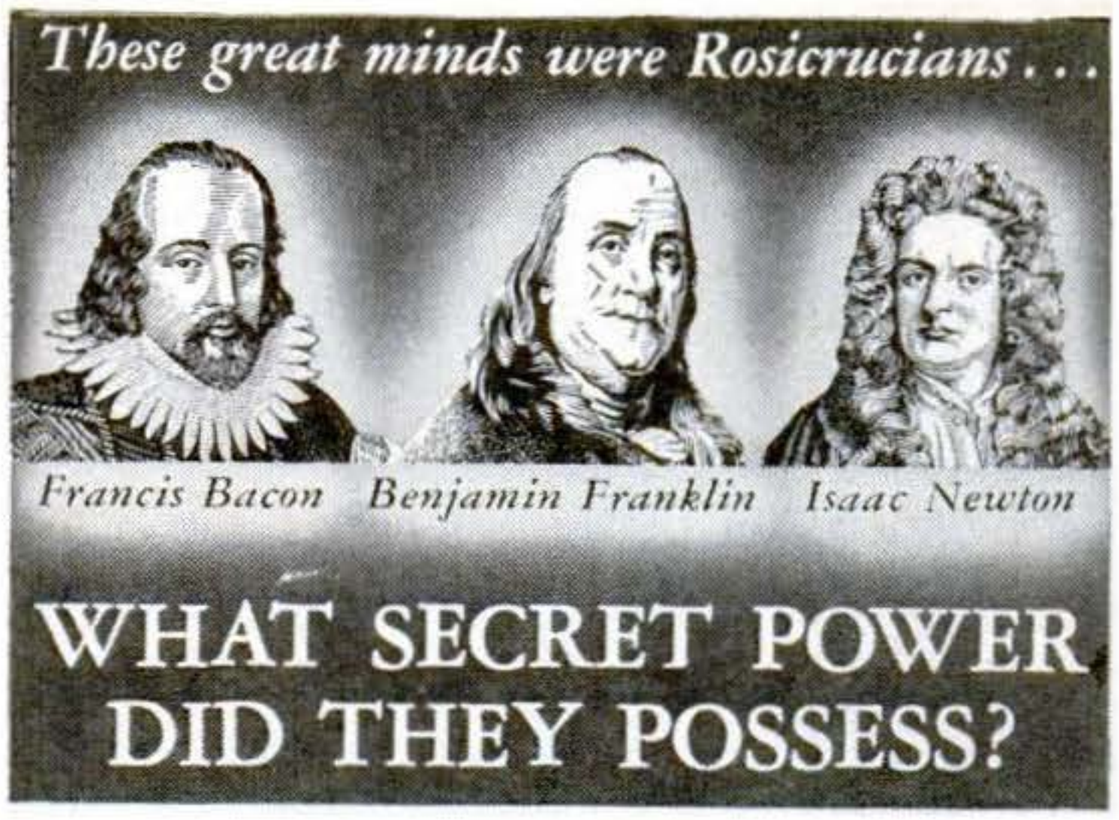

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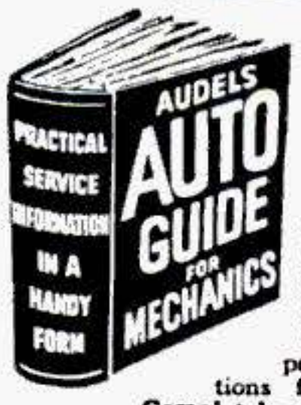

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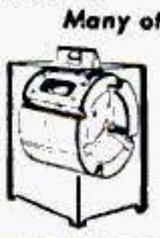

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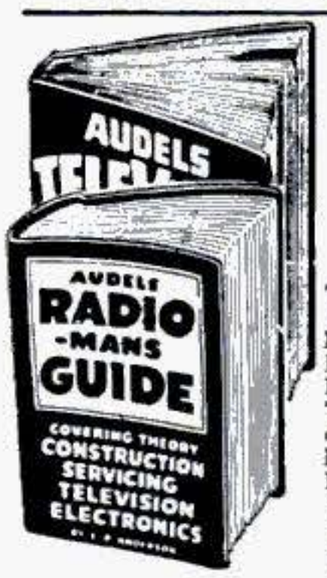

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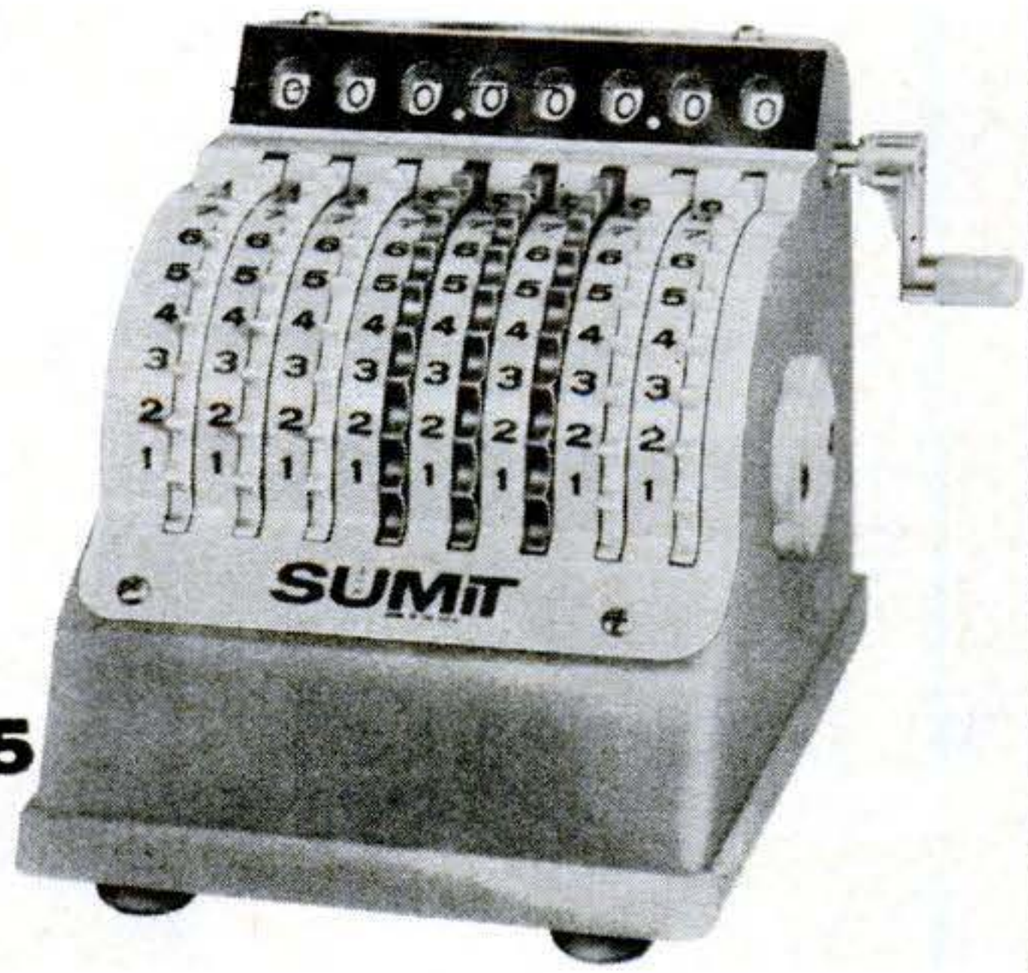

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In this issue, Classified Advertising Starts On Page 264

POPULAR SCIENCE's giant Classified Advertising Market Place, one of the nation's most active business locations, has moved from the "middle of the block" to a brand new site "next to the corner" at the very end of the book—where mail order experts tell us we'll all be doing "business *better than usual.*"

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Turn To Page 264 For The Beginning Of The Classified Section.

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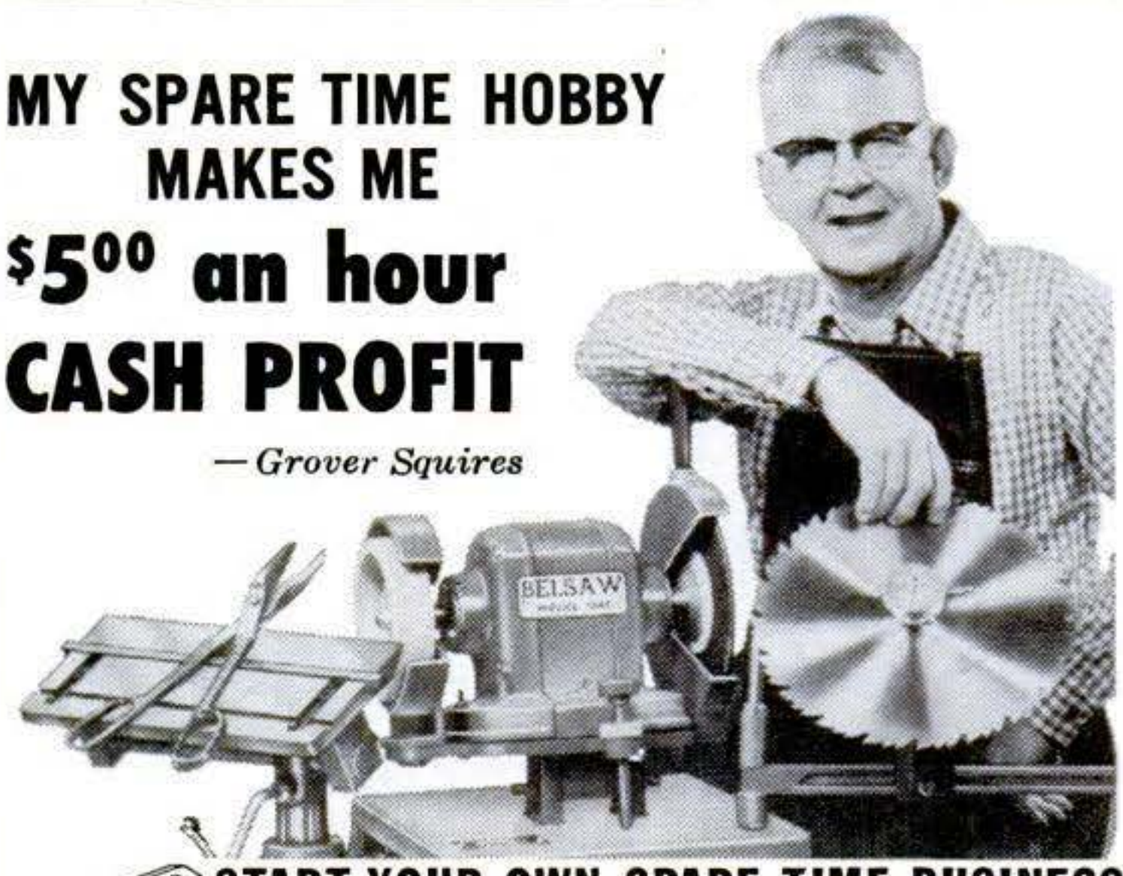

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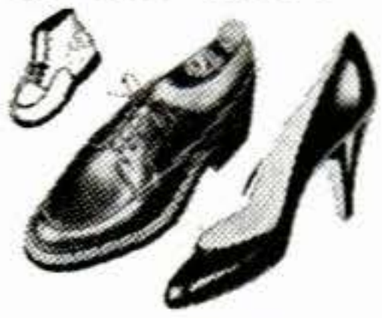

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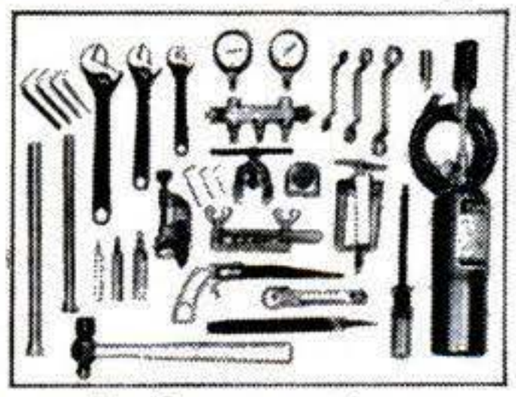

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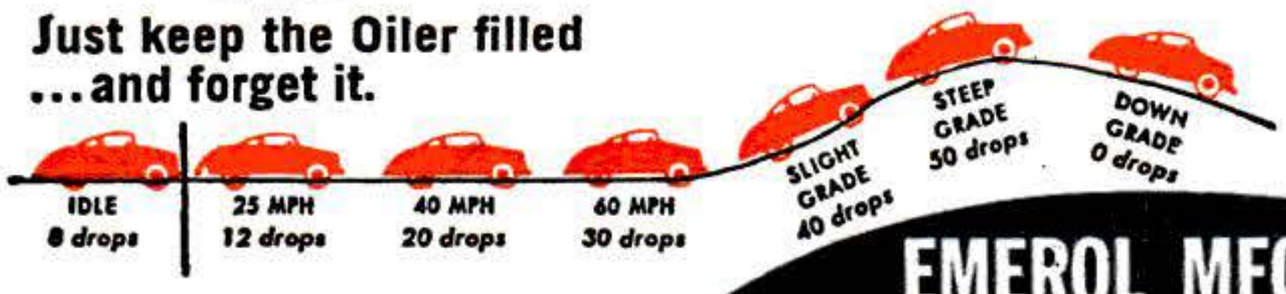

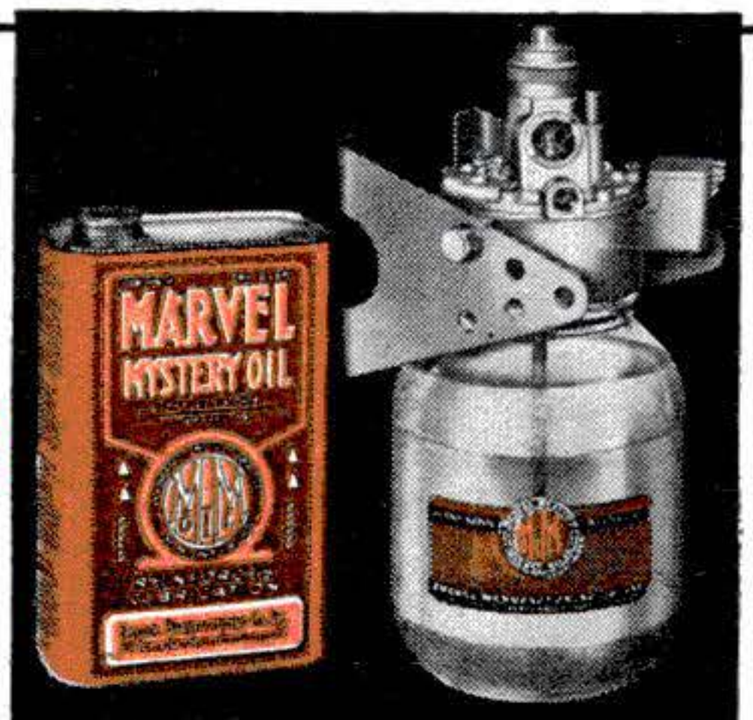

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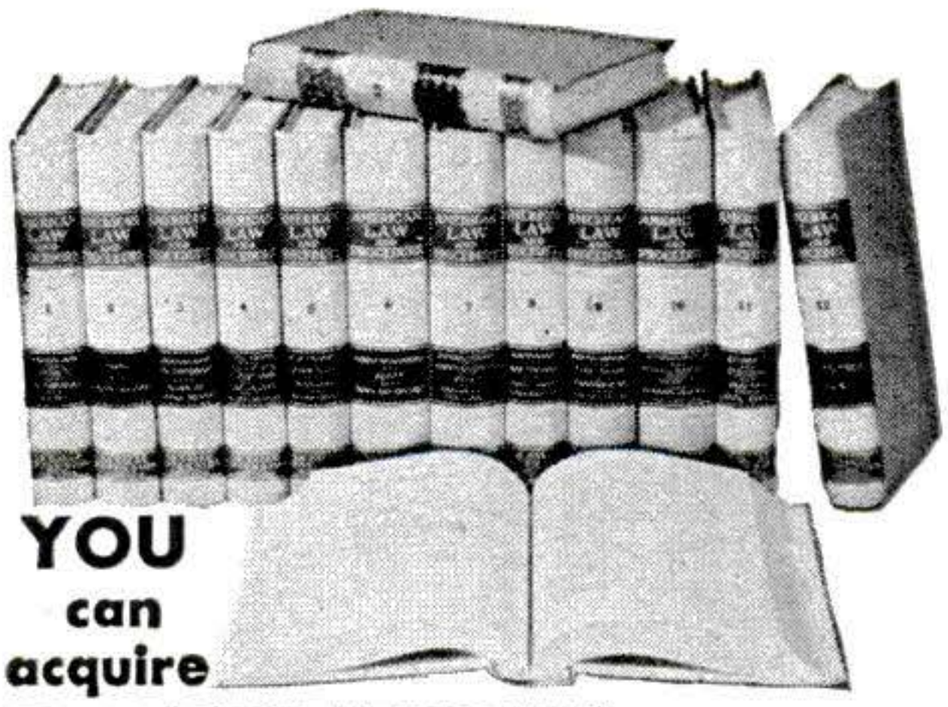

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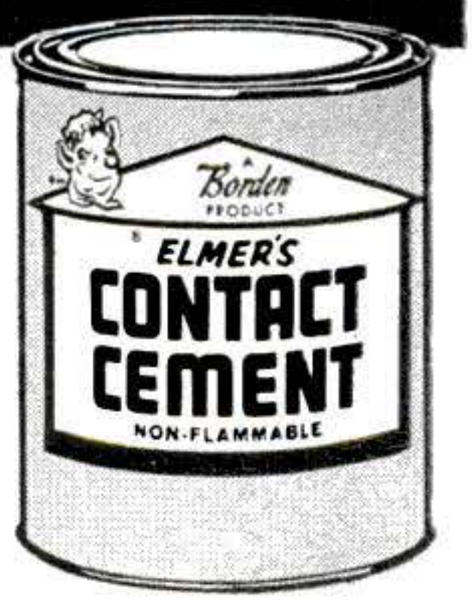

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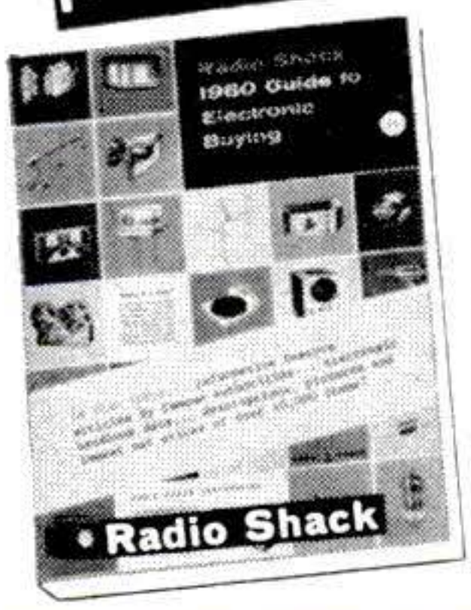

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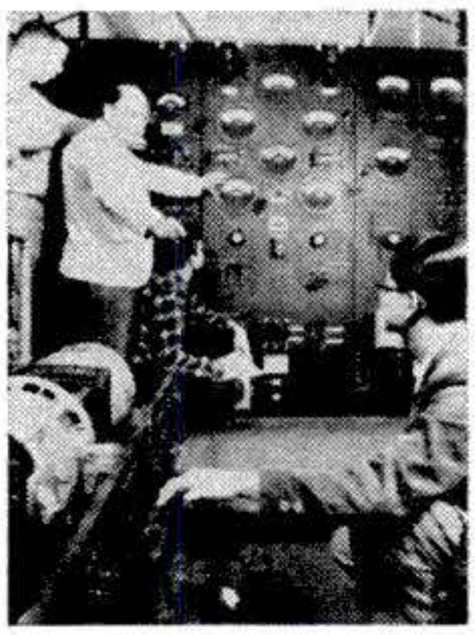

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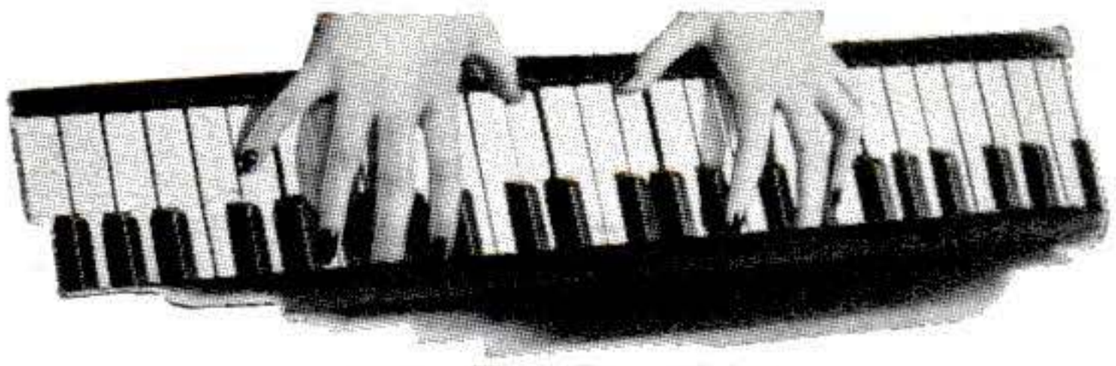

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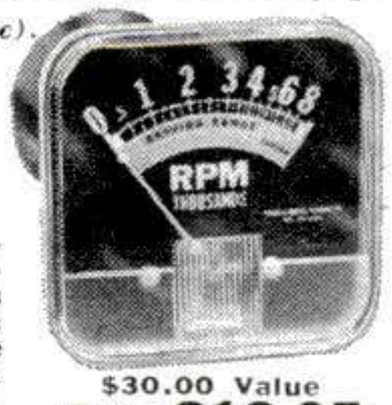

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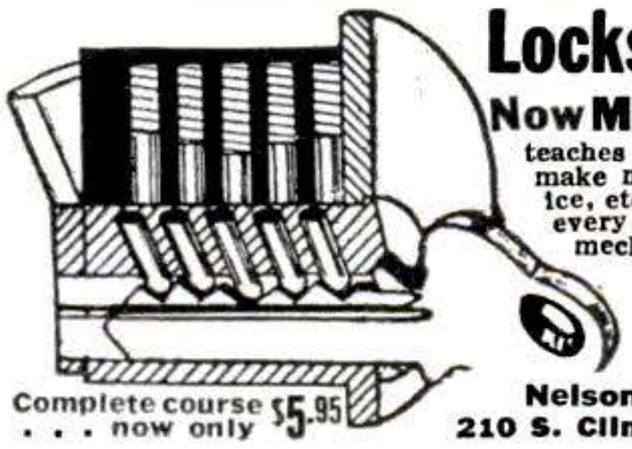

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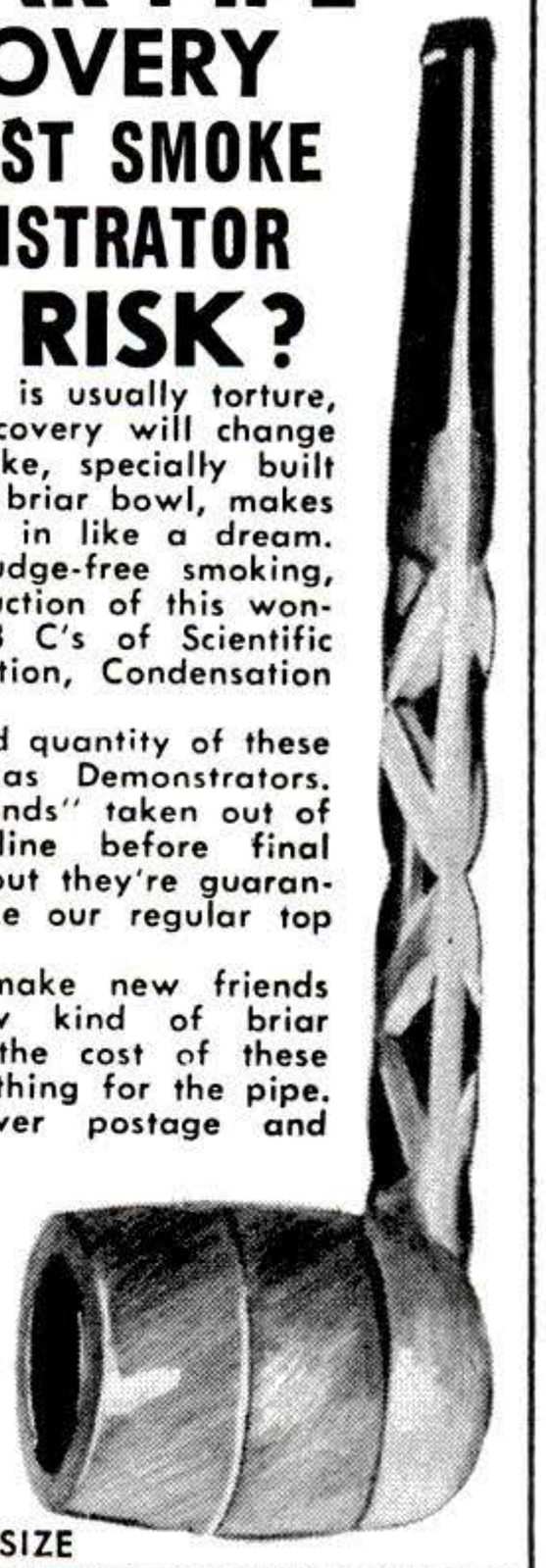

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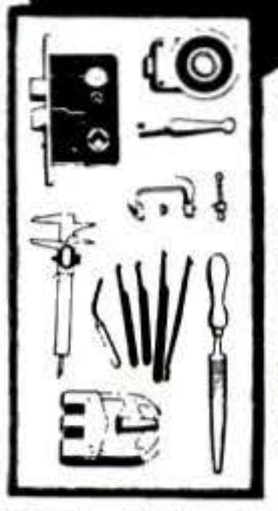

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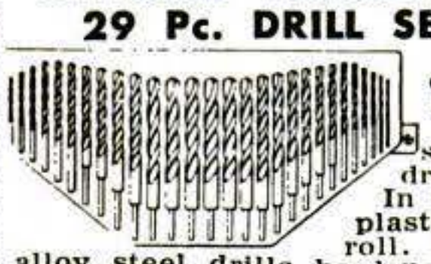

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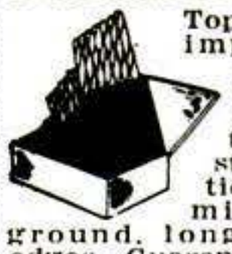

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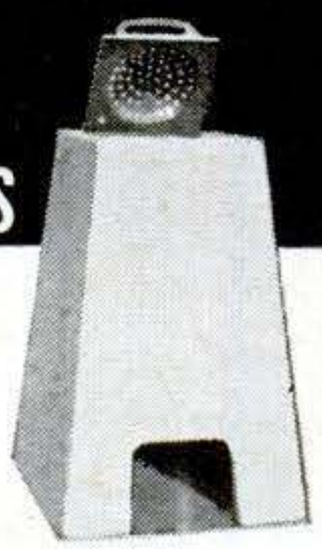

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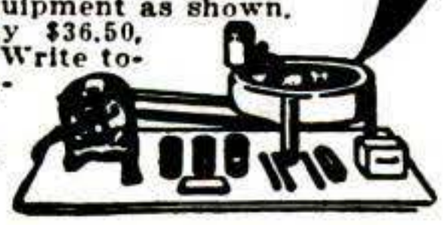

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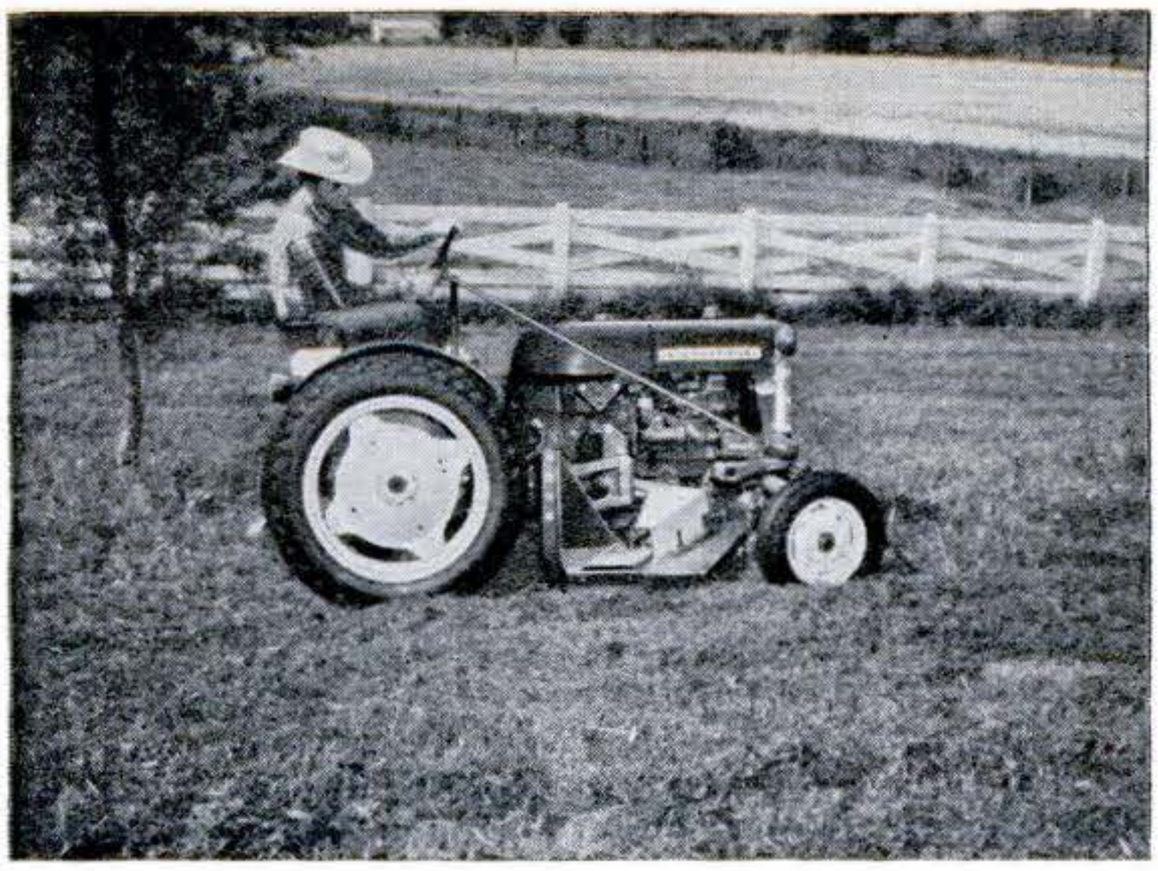

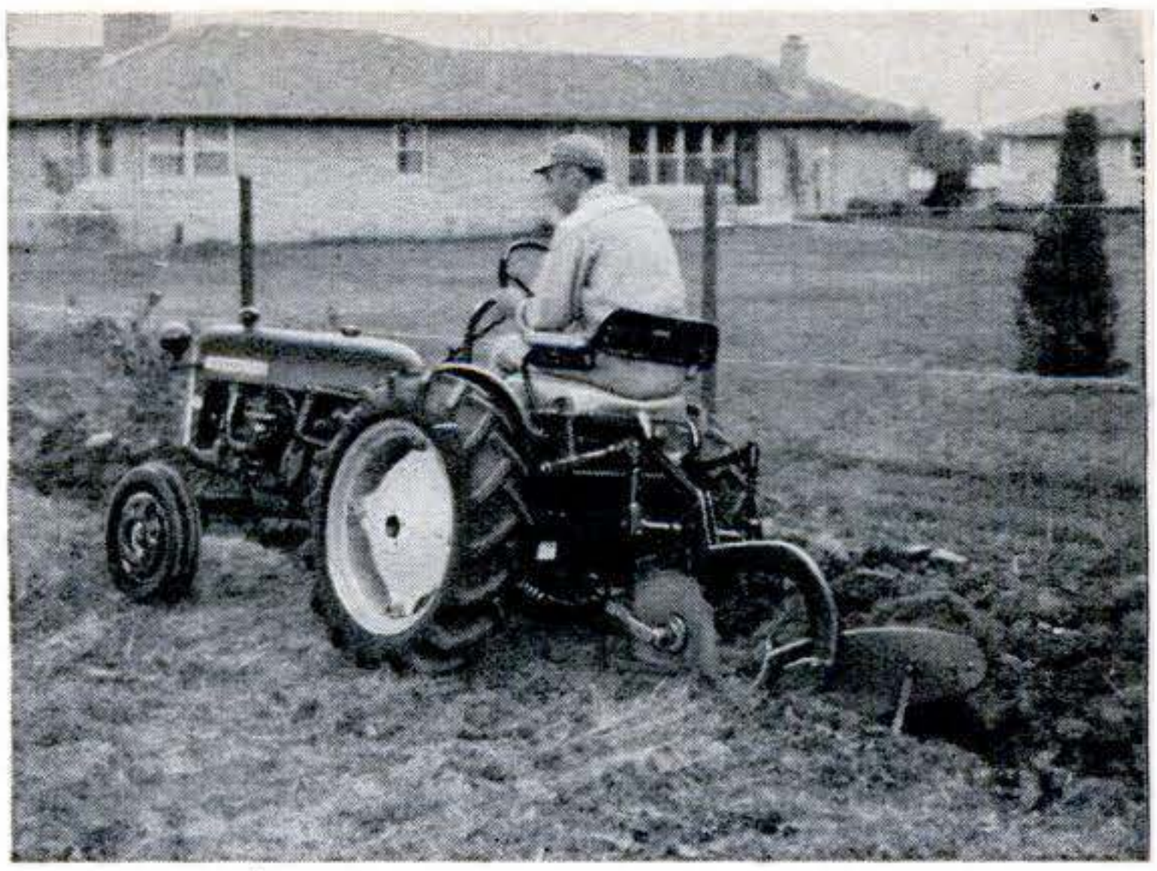

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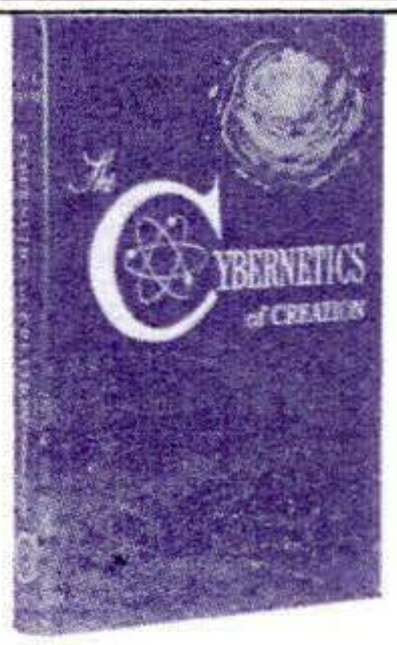

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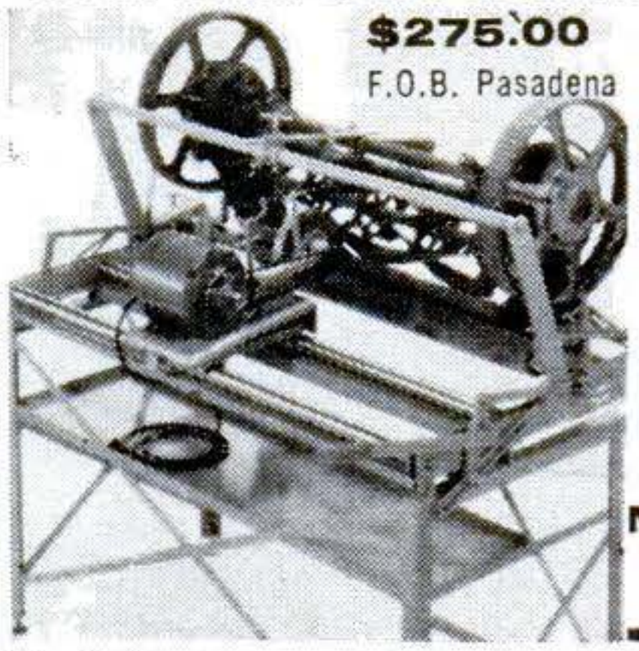

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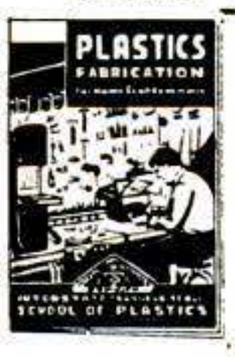

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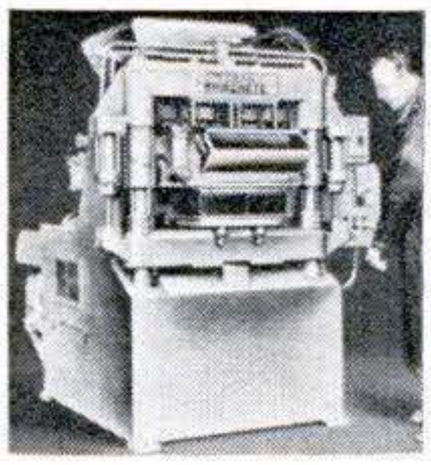

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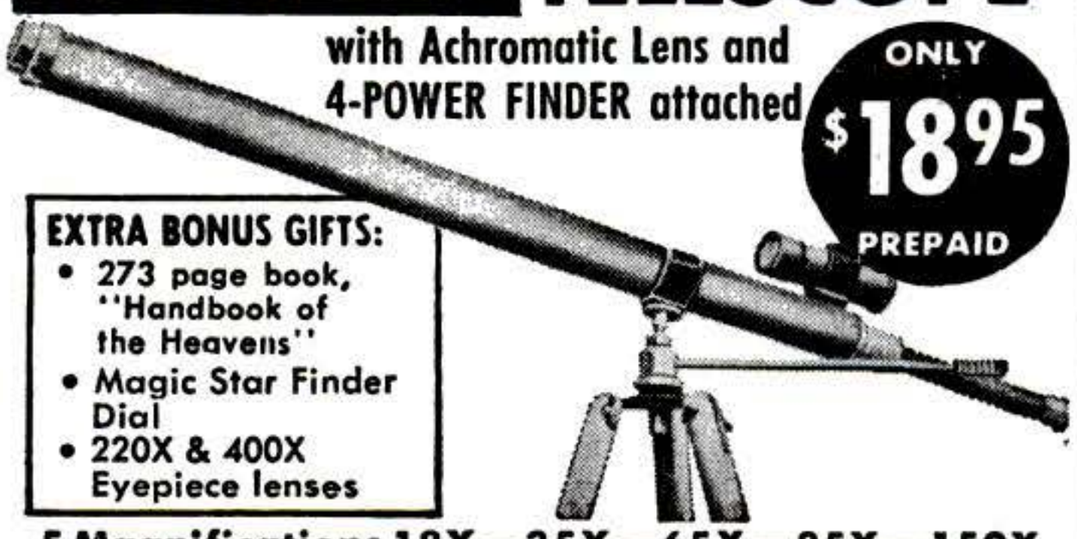

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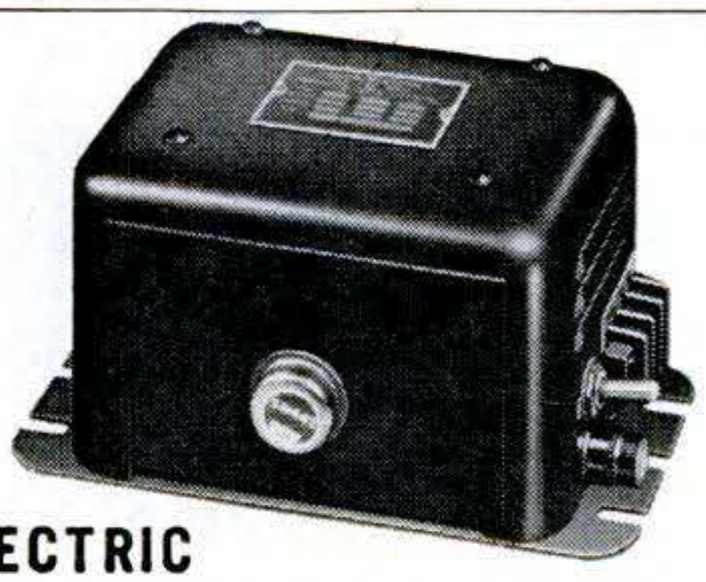

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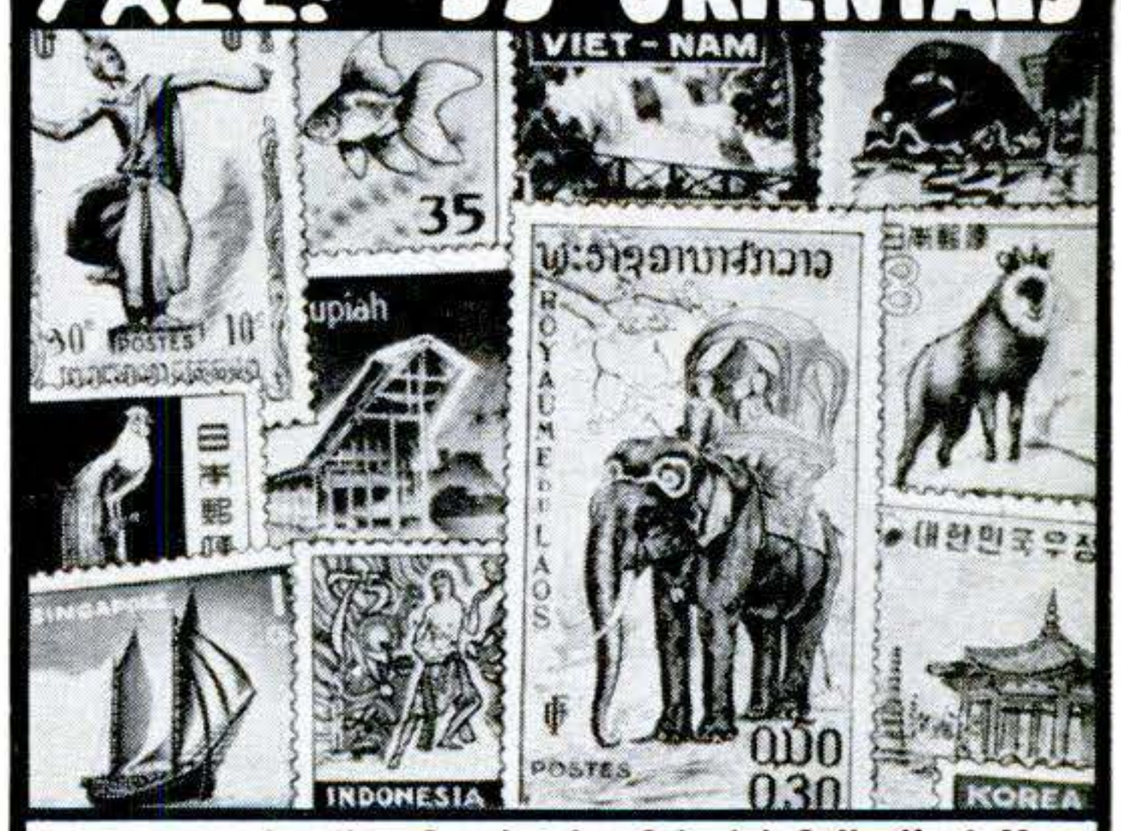

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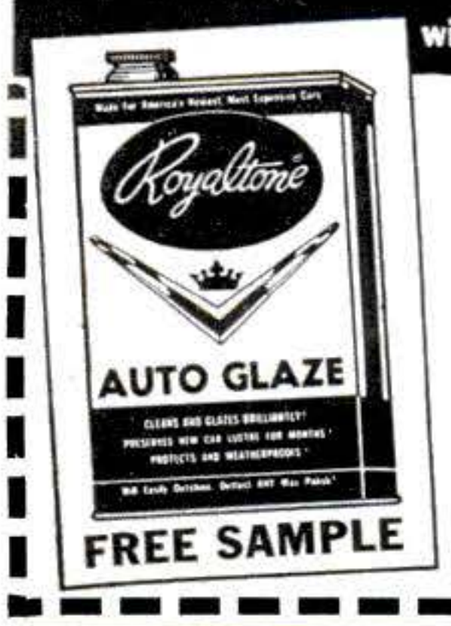

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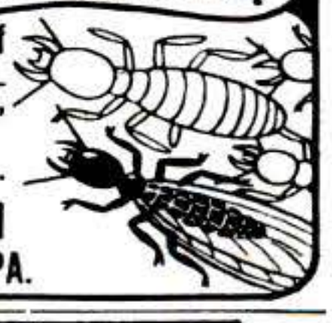

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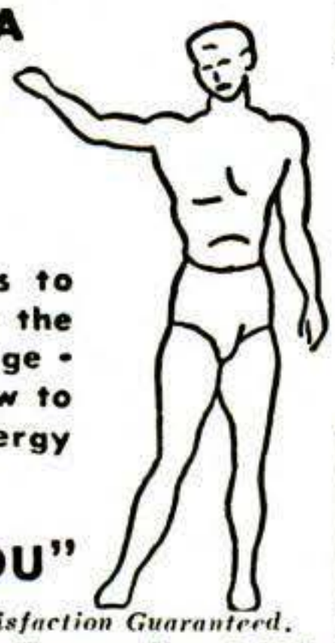

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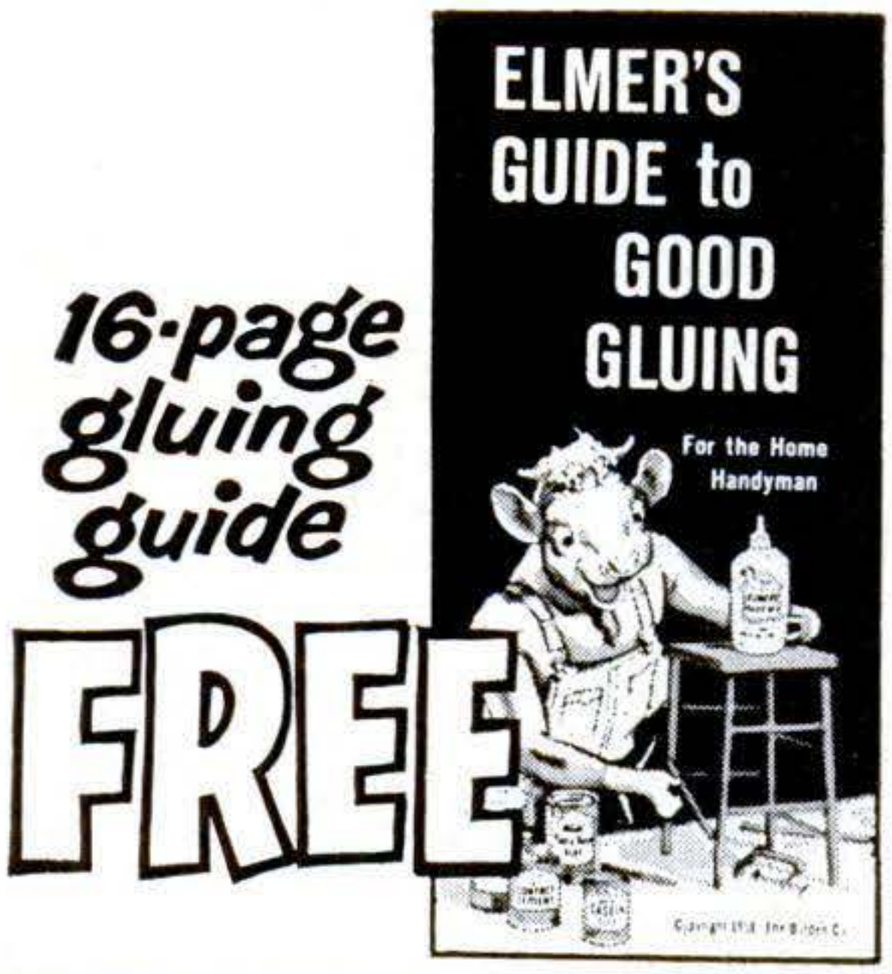

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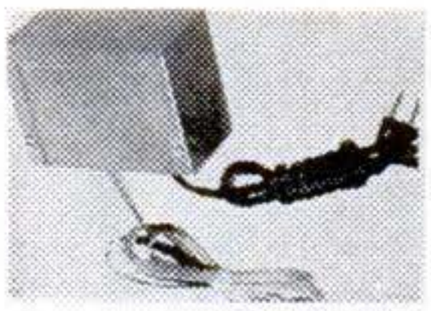

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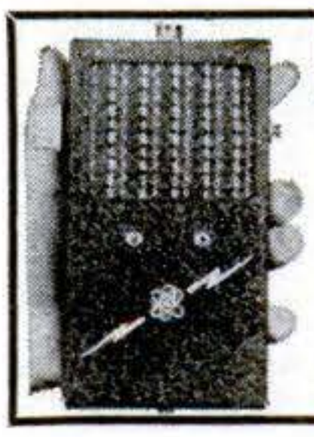

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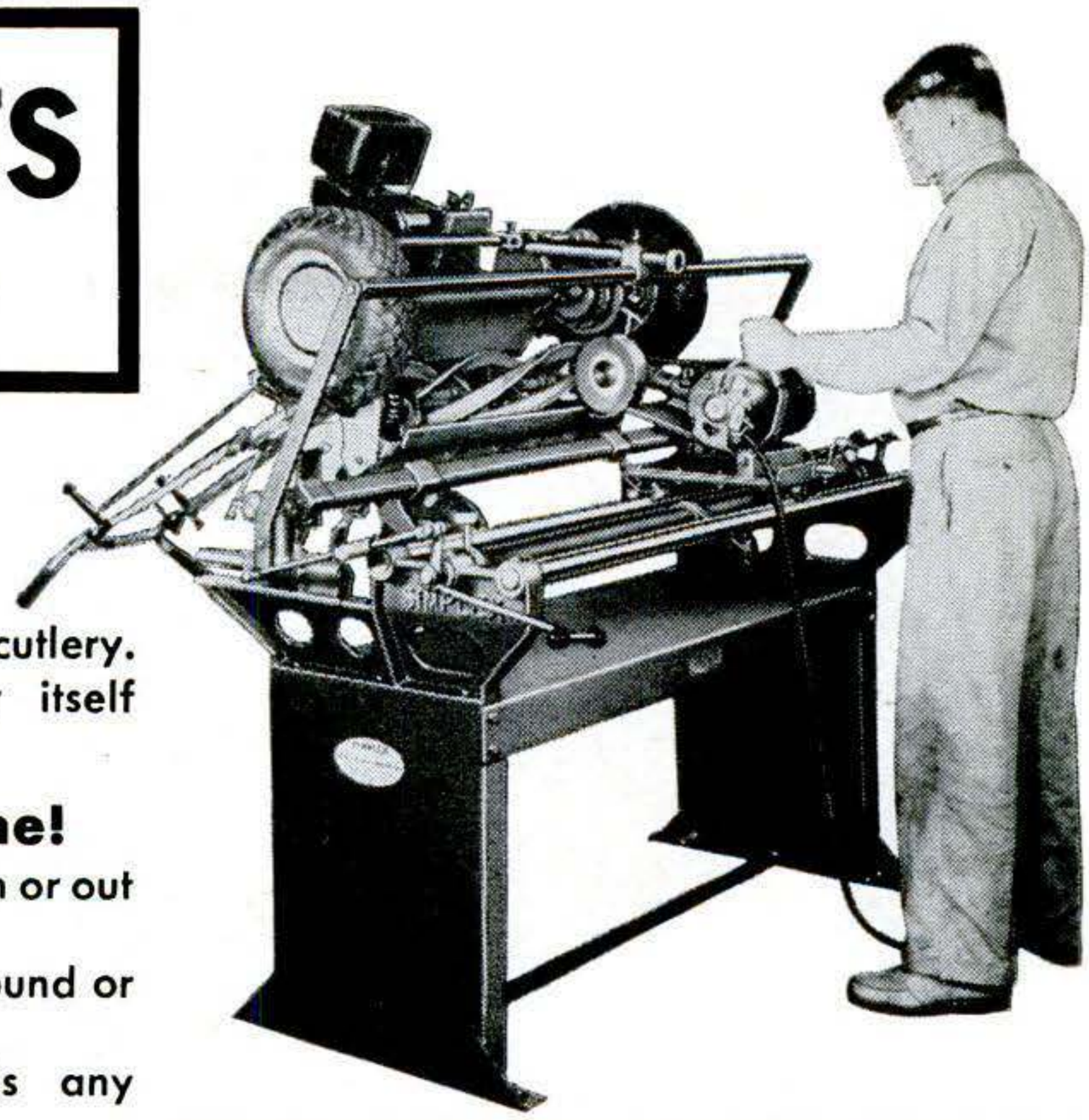

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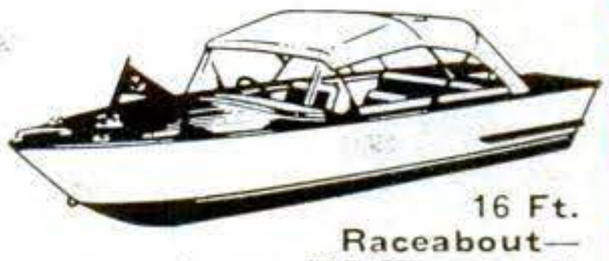

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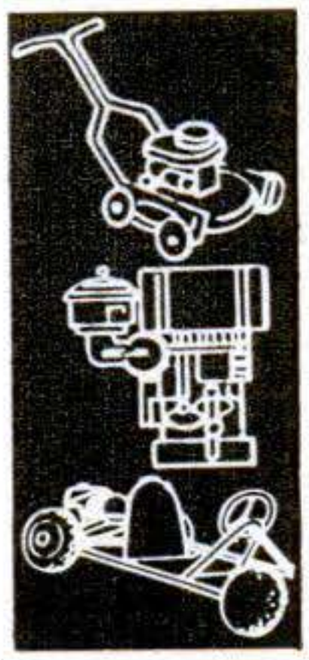

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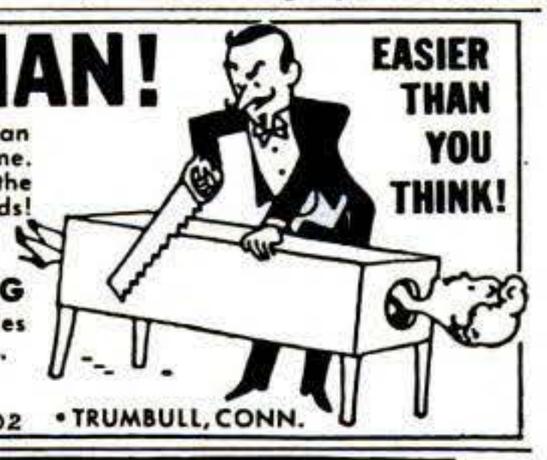

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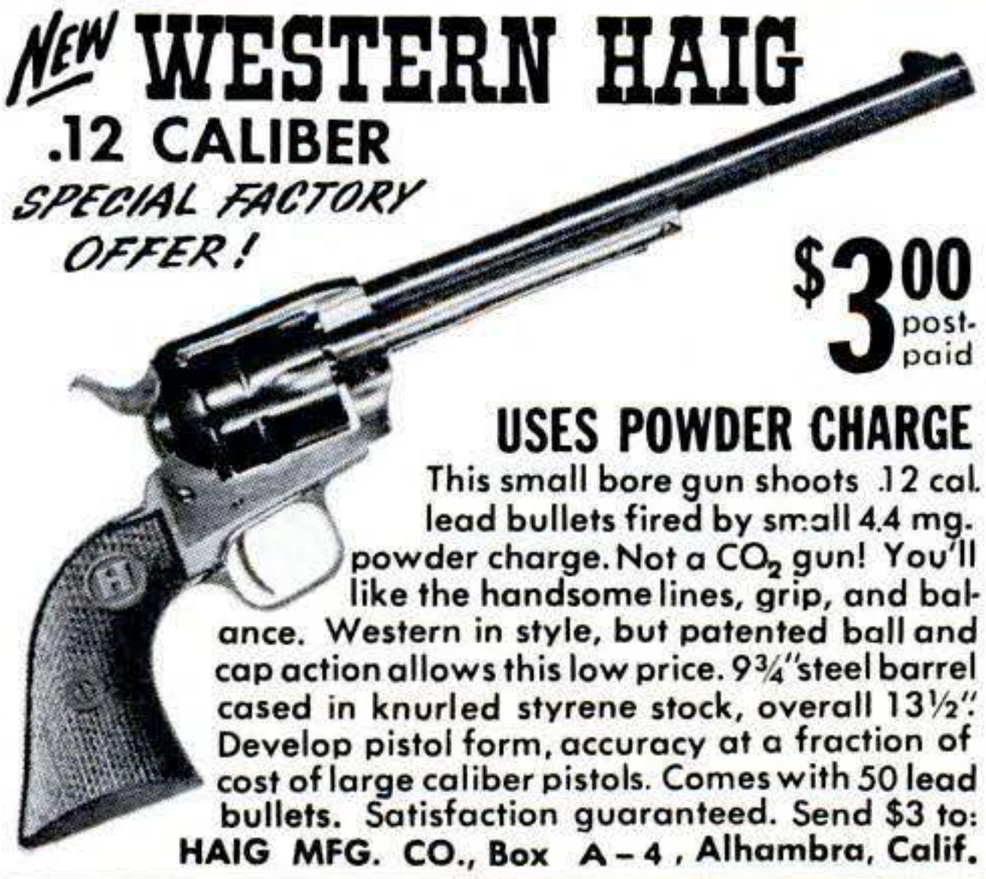

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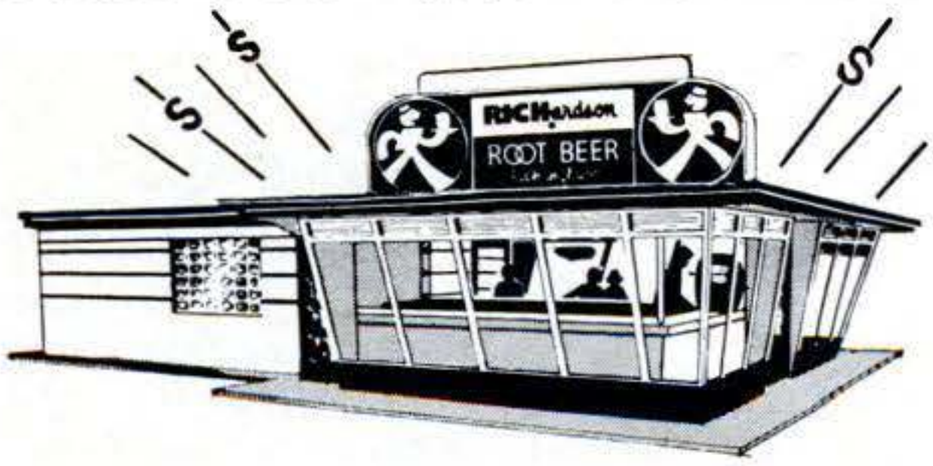

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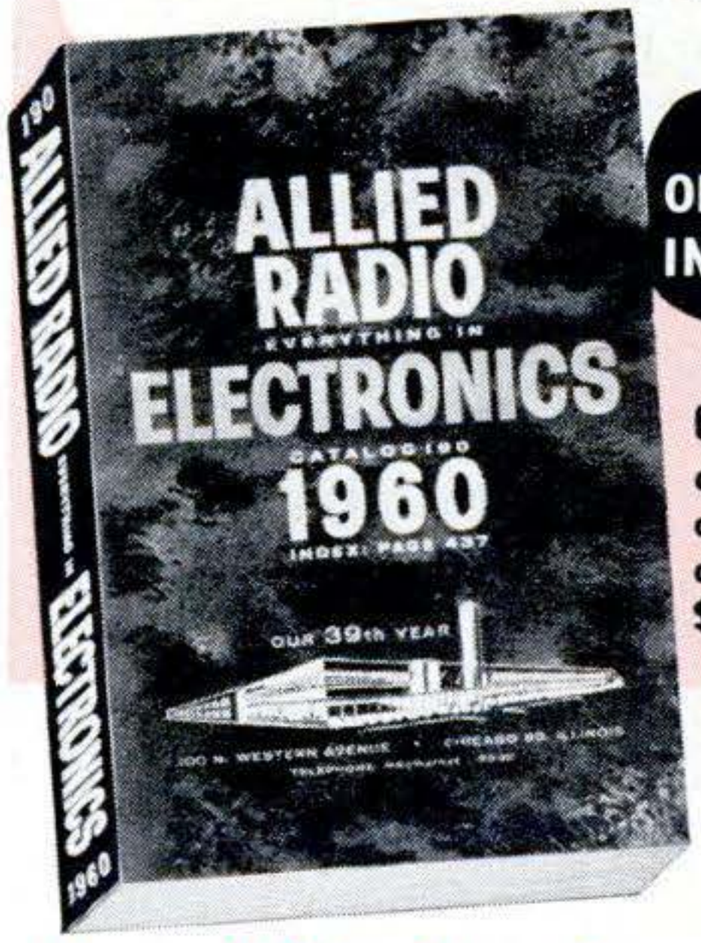

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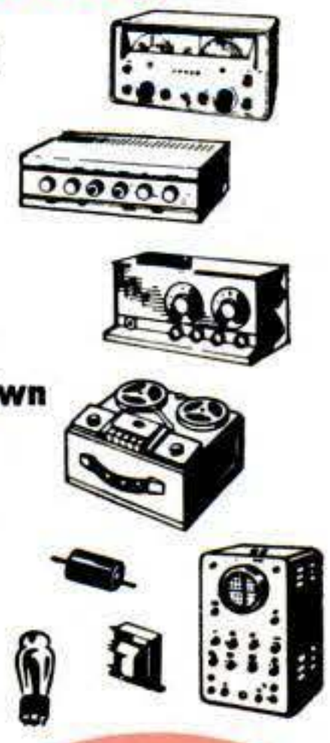

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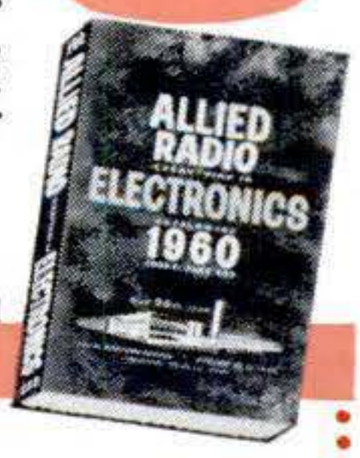

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DETROIT REPORT

By Ken Fermoyle *PS Detroit Editor*

Hot Engines Are Hot News

Racing interest revives in Detroit. The auto manufacturers' "no-racing" resolution is dying on the vine. There will be more undercover factory support behind various cars in stock-car racing this year than there has been since 1957. Ford and Chevrolet already have high-performance models. Plymouth is making a hot engine with special camshaft and solid valve lifters. Pontiac continues to offer its hot engine. Chrysler is expected to go after some speed records with its 300F. And speaking of high performance . . .

Hop-up kits for compacts. New engine options boost the Corvair's horsepower from 80 to 95, the Falcon's from 90 to 128, and the Valiant's from 101 to 148. A heavy-duty chassis package and a four-speed gearbox with synchromesh first, second, and third gears are also now available for the Corvair. All of the new options will be scarce initially.

Hear a clicking in your Falcon? Some early-production models of Ford's compact had a clicking noise that disturbed owners. It isn't serious. Cause is the oil dipstick vibrating against the oil pump's pickup tube. The cure is simple: Bend the lower end of the dipstick slightly outward toward the left side of the engine.

New transmissions coming. Reports that at least one, possibly two, GM cars will have new automatic transmissions for 1961 are correct. Evolved from the familiar Hydra-Matic gearbox, they are designed for rear mounting in unit with the rear axle—thus the term "transaxle."

Although height reduction of the drive-tunnel hump has been cited as the big reason for moving the transmission rearward, there's another major benefit: It will permit independent rear-wheel suspension—and this should mean improved riding qualities.

Big changes in Ford's 1961 lineup? Look for drastic changes in Lincoln, Mercury, and Thunderbird next fall. Reports are that Lincoln styling will be changed completely, incorporating many of the design features of the popular four-passenger Thunderbird, plus elements of the short-lived Continental Mark II. Size will be reduced and appearance will be sportier.

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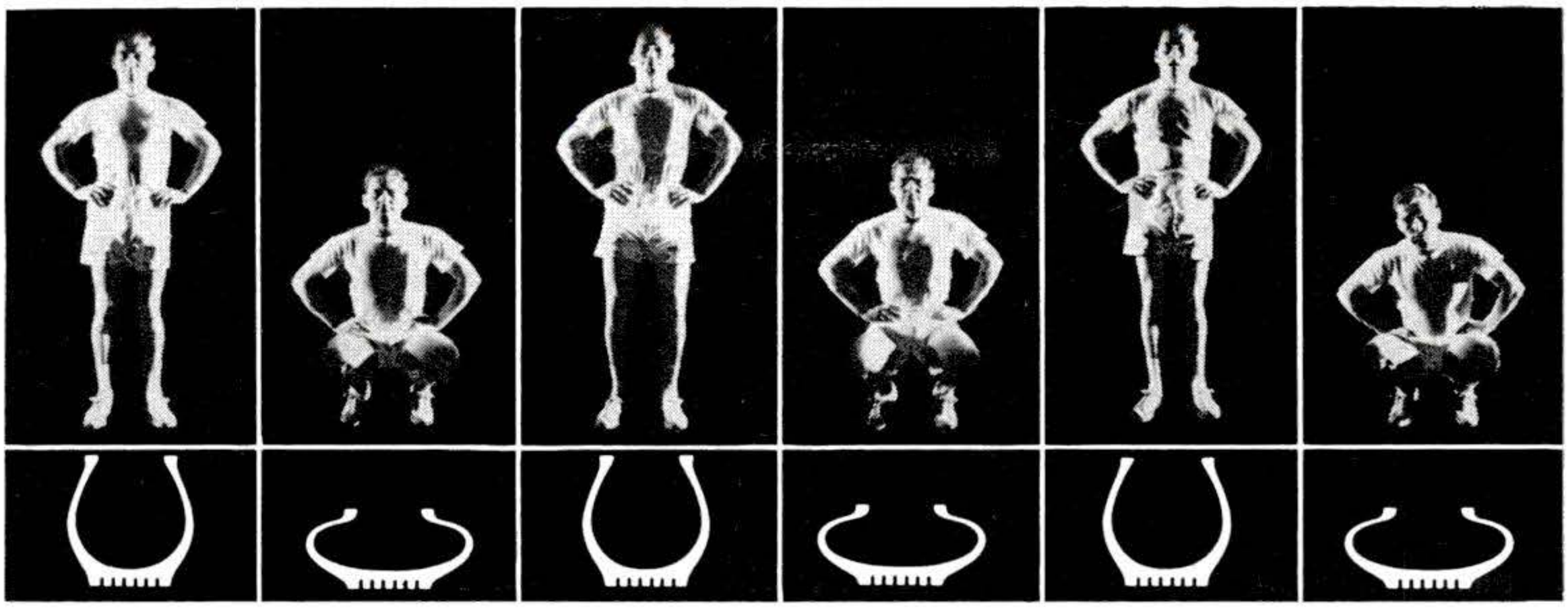
Too much flexing wears out people and tires...



The new *Low Profile* tire shape flexes less reduces heat build-up, increases mileage!

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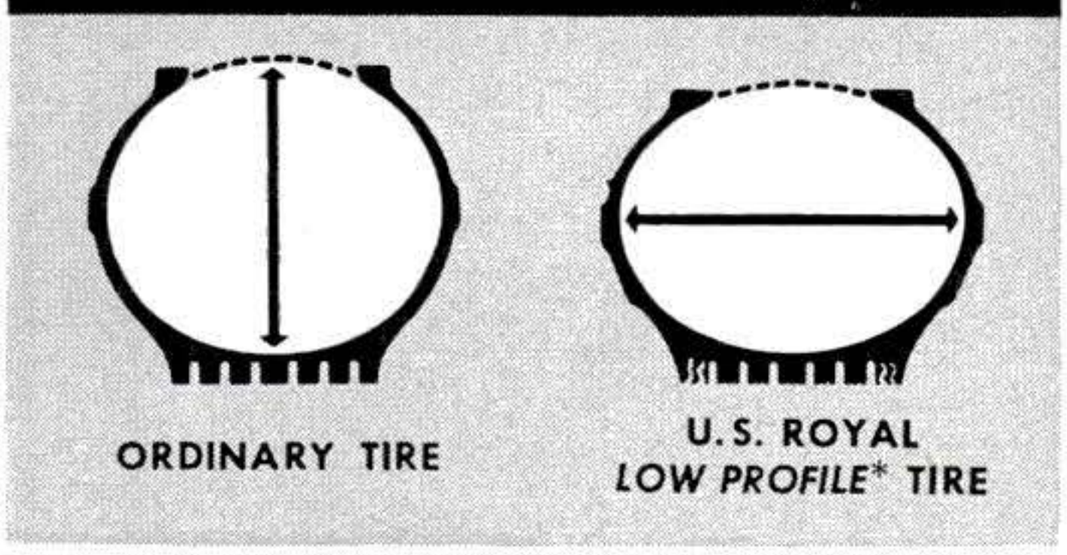

ORDINARY TIRE SHAPE flexes excessively building up intense heat that murders tires, pushes the temperature of ordinary tires above the crucial 240°F. danger zone. **"LOW PROFILE" TIRE** shape keeps temperatures well below danger zone. Running hours at top highway speeds, U. S. Royal "Low Profile" tires stay cooler, keep you far safer.

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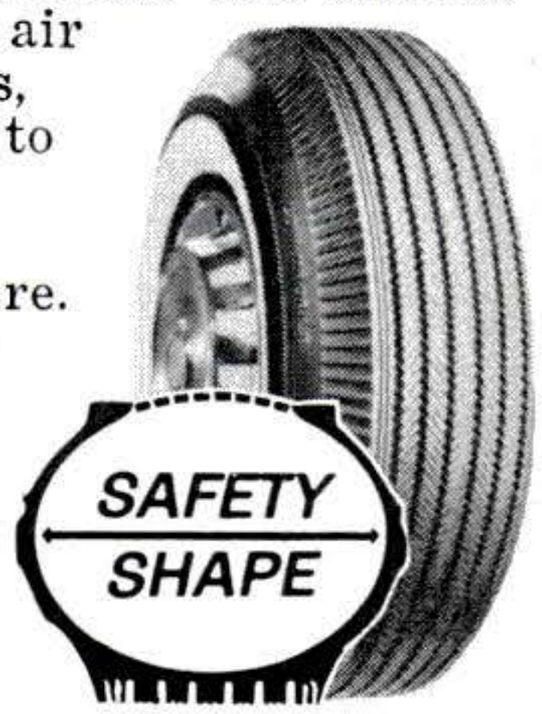

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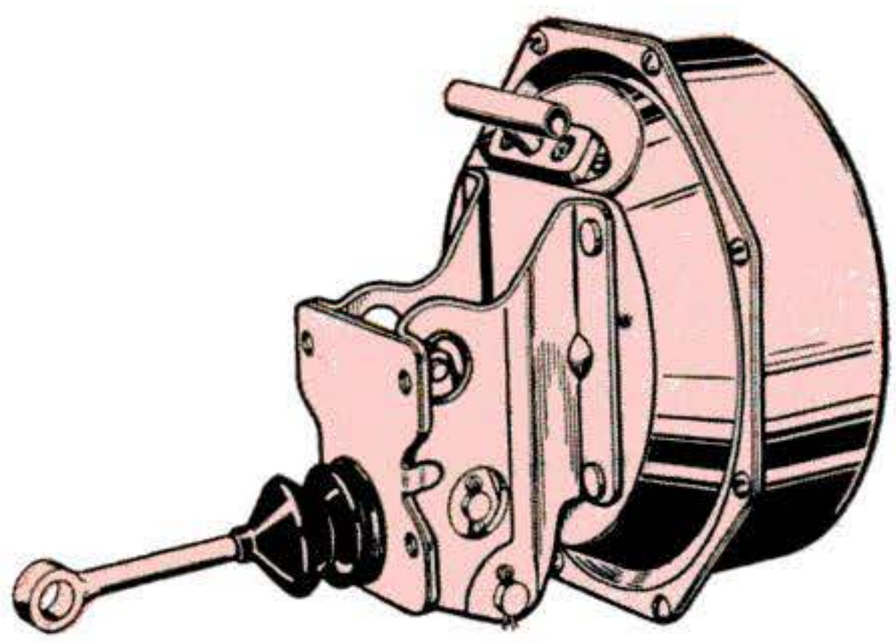
Mercury is due for a major revamping. There will be more interchangeability of parts with Ford. Mercury will probably use a stretched version of the Ford chassis and some of the same basic body stampings. Exterior sheet metal will be different from Ford's.

Most intriguing rumors involve the Thunderbird. Those who have seen prototypes say it has an Italianate look, with a very long hood sloping off sharply at the front. There have been hints that it will have front-wheel drive—which might explain the long hood. More room will be needed up front for the transmission and differential, plus engine, if front-wheel-drive rumors are correct.

Will Cadillac revive LaSalle? The smaller-car furor now involves even Cadillac. There have been vague rumors that the LaSalle nameplate will be seen again on a compact luxury car aimed at the same market as Ford's Thunderbird. This is possible but doubtful at the moment. Cadillac's production capacity is straining to fill the demand for its standard models right now. If this demand slackens and the market for offbeat specialty cars continues to increase, a new LaSalle could appear. If so, it will be small only by comparison with current Cadillacs—and it won't be cheap.

Corvairs need the room. Market researchers learned fast that lack of luggage space was discouraging potential buyers of Chevy's compact car. So the fold-down rear seat (originally listed as a $32 option) will now be used on all Corvairs. The fold-down gimmick more than doubles the storage space in the rear-engine car.

Power brakes in a package. You can now get a power-brake unit that can be installed in the Valiant in 60 minutes. Mounted on the left side of the firewall, it doesn't interfere with engine maintenance. All tubing is flared and cut to length so that vacuum lines can be fastened quickly to the intake manifold and vacuum tank. The original master cylinder is easily installed on the booster assembly. Step-by-step instructions come with the package, obtainable from Valiant dealers.



Electronic highways closer? GM's research lab has unveiled a comparatively simple first step toward automatic roads. Wires would be embedded along lanes, radiating a weak two-kilocycle signal. Small pickup units would hang from both ends of a car's front bumper. They'd trigger different warning tones if a car veered too near the edge or center line. Purpose: to alert dozers, and to guide in fog or snow.

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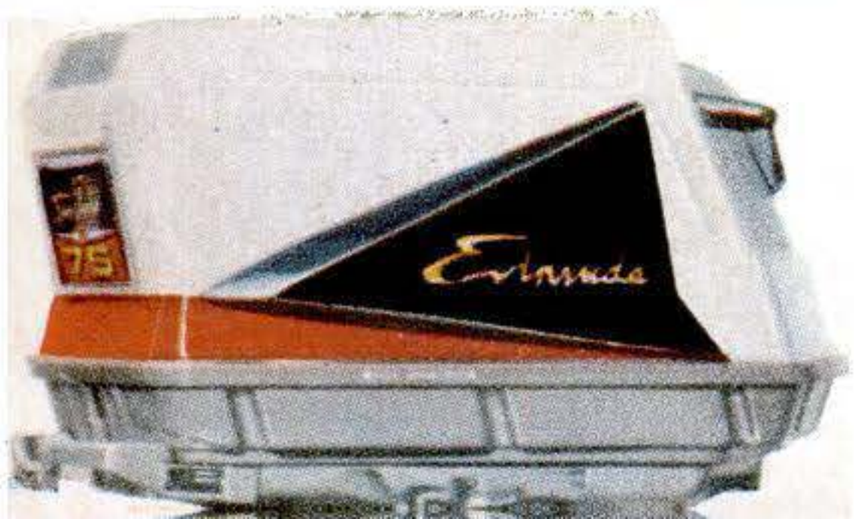

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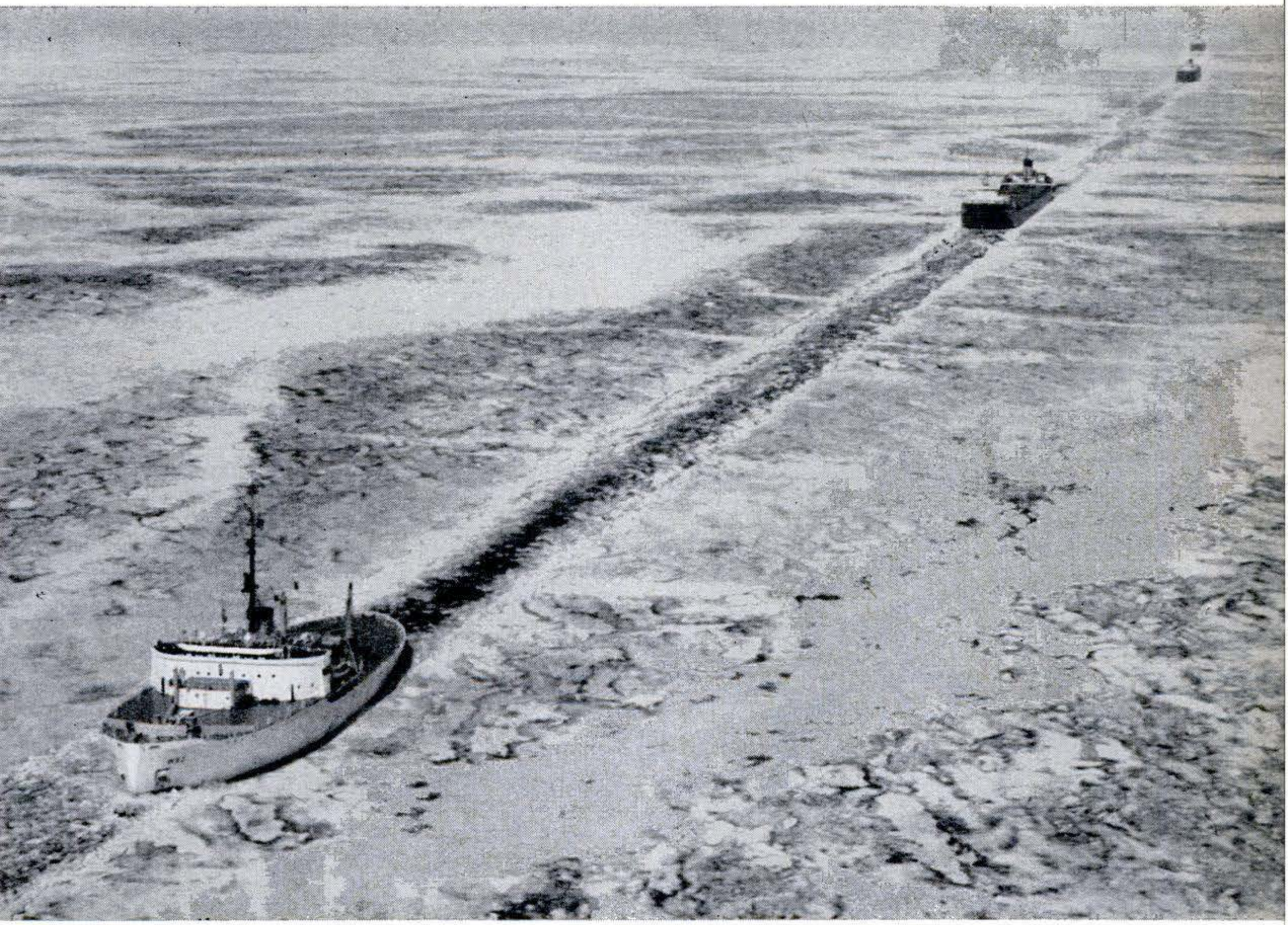
Cracking the Great Lakes Ice Jam



The icebreaker Mackinaw plows a channel in Whitefish Bay for three huge ore carriers.

Led by the 10,000-hp. Big Mac, a Coast Guard task force bulls through the frozen lakes to free them from winter's grip

By George J. Barmann

ICE-CRACKING time is here again on the Great Lakes. Tankers as well as ore and coal carriers wait impatiently for the Coast Guard to reopen frozen channels. Stakes are high: For each day the ships stay icebound, shipowners lose $10,000,000.

Exactly when the icebreaker Mackinaw will lead the first convoy northward in single file depends on the Ice Committee. Made up of ship operators, weathermen, and Coast Guard officers, this group meets each spring in Cleveland. It sifts daily reports from shore observers and from Coast Guard pilots who fly over much of the ice-locked route in two amphibians and five helicopters.

When the committee gives the order,

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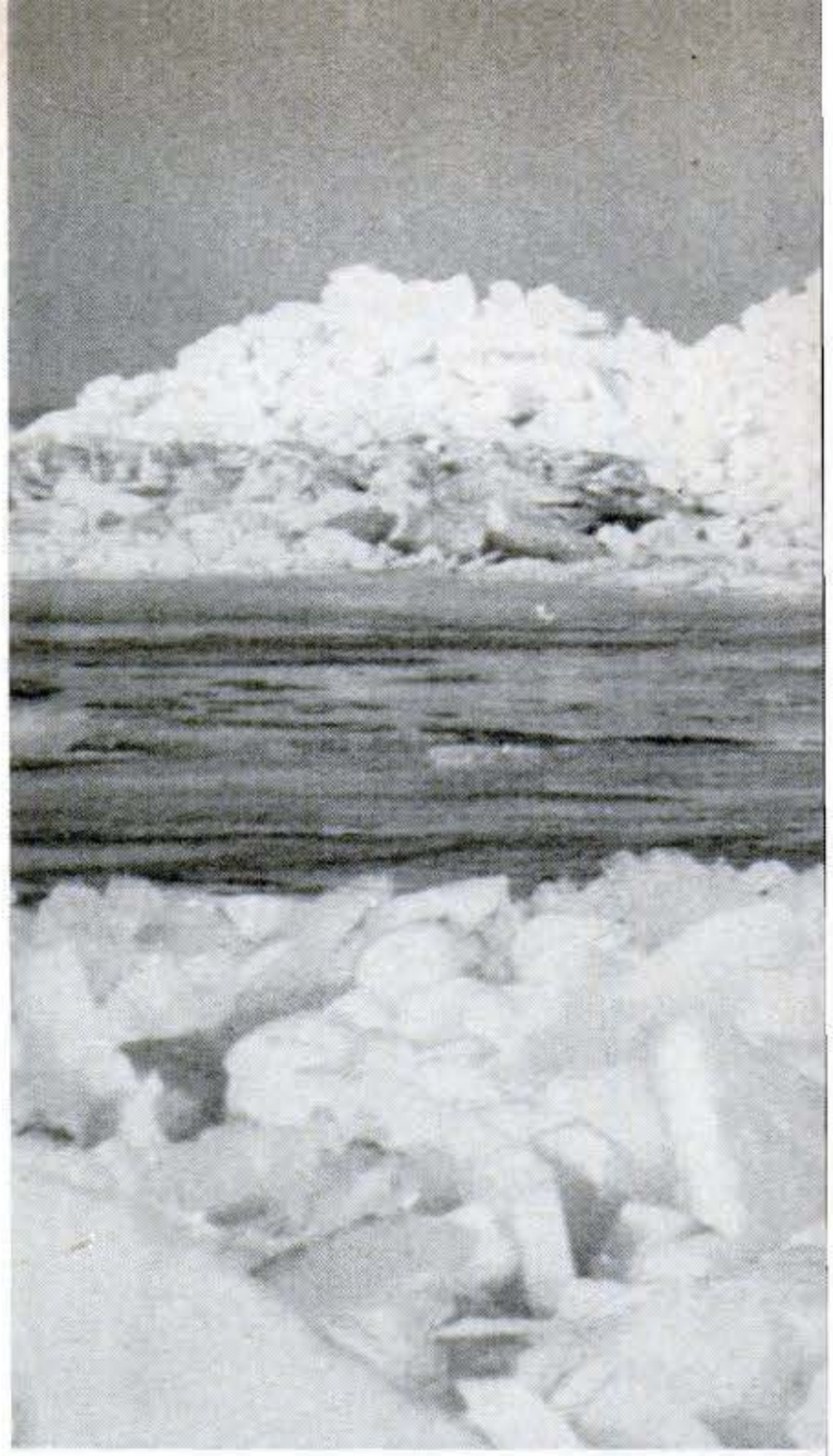
Big Mac, followed by her Task Group, will begin by crunching head-on into the Straits of Mackinac. Here blue ice is usually 10 to 18 inches thick; windrows are piled as high as eight feet. Then she will fight her way across the top of Lake Huron and up the 86-mile-long St. Marys River to the locks at Sault Ste. Marie. Beyond is Whitefish Bay, blocked by field ice 24 to 30 inches thick. And finally there's the long westward run through Lake Superior to Duluth.

That first trip will probably take weeks. Despite a helicopter scout, the Mackinaw may hit ice fields so tough she will have to back off and ram again and again. Strong winds may shove ice floes back almost as quickly as Big Mac nudges them aside.

The Task Group does more than break a path for the first cargo ships. Two or three 180-foot buoy tenders are in the convoy, their decks loaded with channel markers that must be anchored again. They also carry crews for 20 or so manned lighthouses along the way. Heavier-hulled tenders double as light icebreakers.

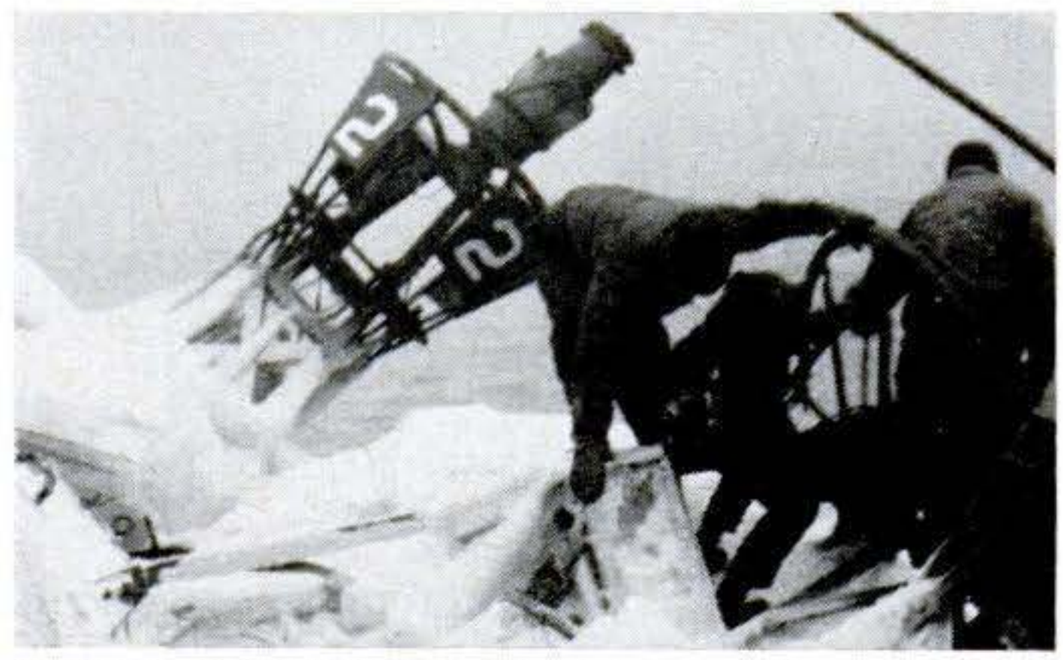
Last year the lakes opened officially on April 16. By then ships of 3,000 hp. or more were able to move, still with some icebreaker help. But it was April 30 before low-powered vessels could navigate freely. What about this year's timetable? Even old hands on the lakes won't say—the weather is never exactly the same.



A pontooned helicopter guides

THE ICE IS TWO FEET THICK, a crewman from the icebreaker discovers. Tied to the ship by a safety rope, he measures with an L-shaped pole that's marked and notched at each foot.

TANKER FROZEN IN on Lake Superior will be pried loose by Big Mac (foreground) and led to safety. Sometimes ice pressure buckles the plates of the thinner-hulled cargo vessels.



BUOYS TO MARK THE CHANNEL are dropped back in the water after a winter ashore. Frozen topsy-turvy on the deck of a buoy tender, they're lifted for the big splash by a boom and winch.

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Mackinaw along the best path through the ice. Copter is carried on the ship's afterdeck.

THE MACKINAW'S SKIPPER, Capt. J. P. German, runs the convoy of Coast Guard and merchant ships from the icebreaker's bridge. He decides which cargo ships can safely make the trip.

SHORE LEAVE for the Mackinaw's crew means a brief walk on the jagged slabs of Lake Superior ice. But the 114 officers and men welcome the change after days of confinement aboard ship.

LIGHTHOUSES ARE MANNED AGAIN at the start of each shipping season. Here a crew with supplies prepares to land from a Coast Guard cutter at Lake Michigan's White Shoals Light.

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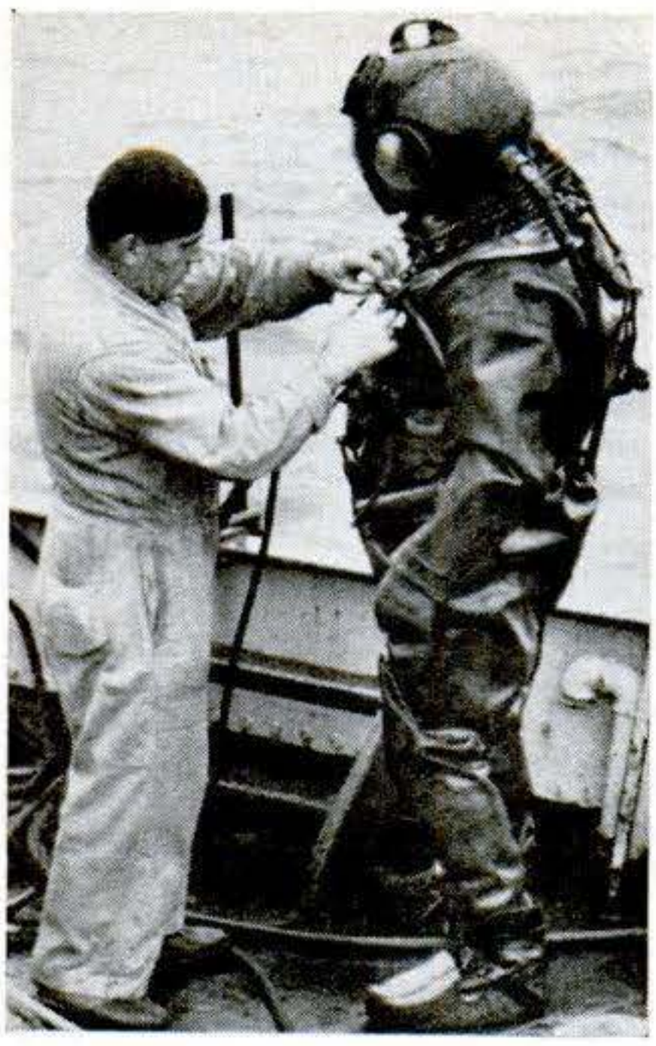


Deadliest gas shells harvested in Baltic

1. FINAL CHECK is given the equipment of a diver who will descend 80 feet in Baltic waters to search for poison-gas shells sunk with two Nazi ships during the last days of the war.

2. SKINDIVER SNAPS PHOTO of one of the lethal shells sticking out of the mud on the bottom. He will place it in a steel basket to be hauled aboard the salvage ship standing nearby.

German seamen are salvaging deadly poison-gas-filled shells from the Baltic Sea off the coast of Flensburg, West Germany. They were cargo of Nazi ships scuttled at the close of World War II.

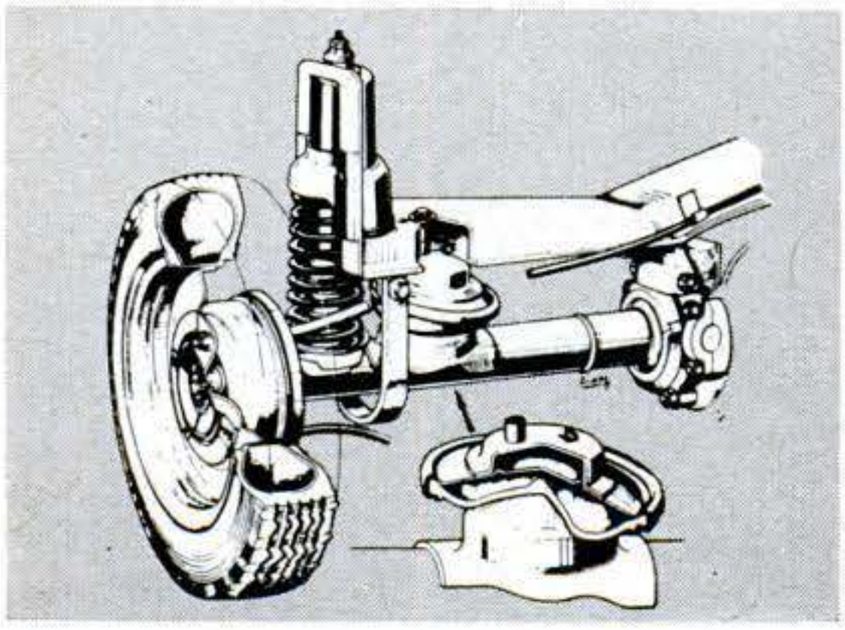
During the war Hitler's scientists developed a poison nerve gas they called "Tabun" and encased it in 100,000 explosive shells. For fear of retaliation, the shells were never used.

Now the shells are a peacetime menace to shipping—too close to the surface at only 80 feet down. The German government is salvaging them, deactivating their fuses, and will sink them at a safer depth—12,000 feet—in the Atlantic Ocean.

Sporty import has convertible tops

RENAULT'S NEW CARAVELLE comes in three models: hardtop coupe, hard- and soft-top convertible. Average price: about $2,500.

AUXILIARY SUSPENSION on the Caravelle has an air bag at each of its rear wheels to stiffen the ride as the load increases.



The new Renault Caravelle wears either a soft or a hard top on its 14-foot-long body. A 40-hp., four-cylinder rear engine powers the French import, and three- and four-speed manual transmissions are offered as options. A bench seat in back holds two passengers.

The Caravelle uses Renault's new Aerostable auxiliary suspension: an air bag at each rear wheel and a rubber pad at each front one. They assist the regular coil springs under a heavy load.

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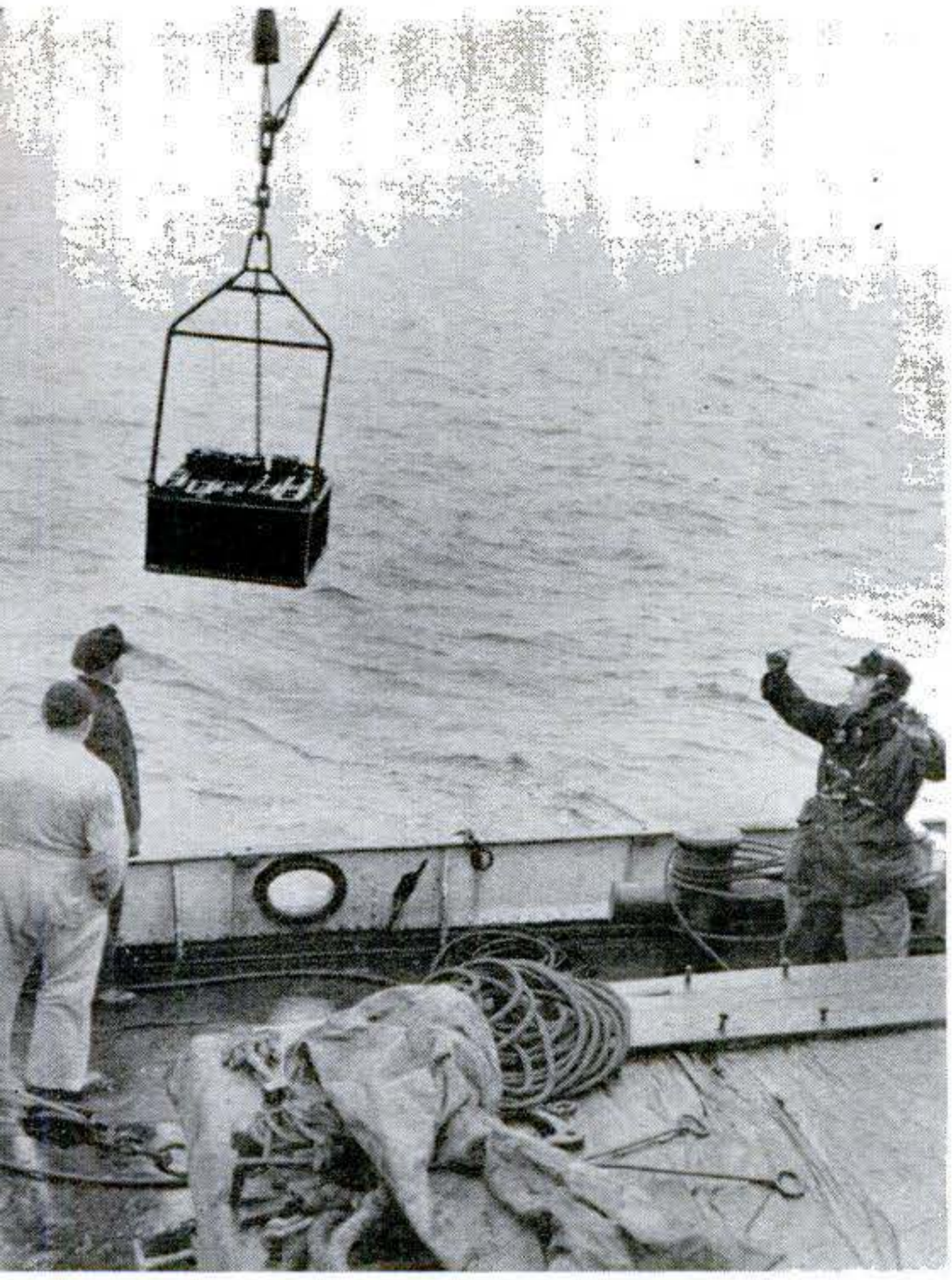
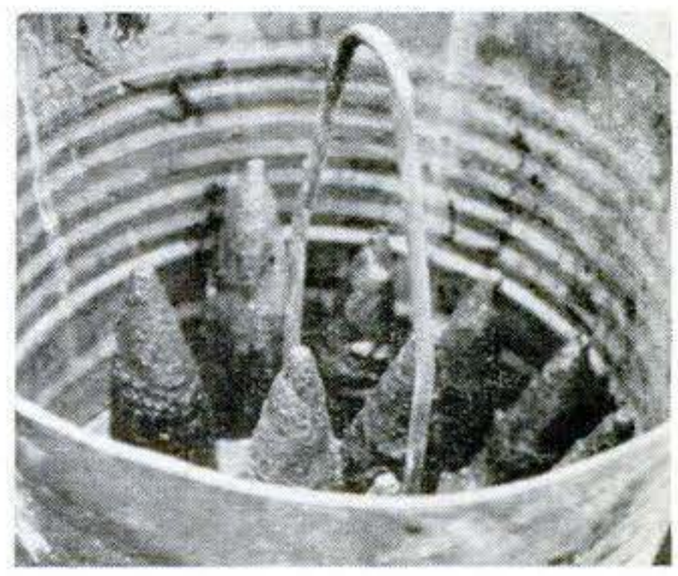


3. UP FROM THE DEPTHS comes a basket laden with a deadly harvest. The seaman at right signals the operator of the winch to swing the load in gently.

4. RUBBER GLOVES AND CLOTHING give protection to one of the defusers as he handles a shell. After scraping off the slime and rendering the shells nonexplosive, he will paint the tips with a salt-water-resistant coating to prevent leaks of the still-dangerous gas.

5. DEFUSED SHELLS are put in barrels, covered over with concrete, and stored in the hold. When all have been removed from the area, the ship will sail for mid-Atlantic where the poisonous cargo will be lowered to a safer resting place.



Plastic-foam tents may make life easier for GIs

Doorway is cut through with a bayonet.

Two chemicals mixed and sprayed over an inflated canvas dome may simplify the erection of Army shelters. The plastic foam expands to some 10 times its volume, hardens in less than an hour. The substance is light in weight and a good insulator for both men and materials in the field.

Shelter is six feet high and 12 feet in diameter.

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Testing Chrysler's new compact car:

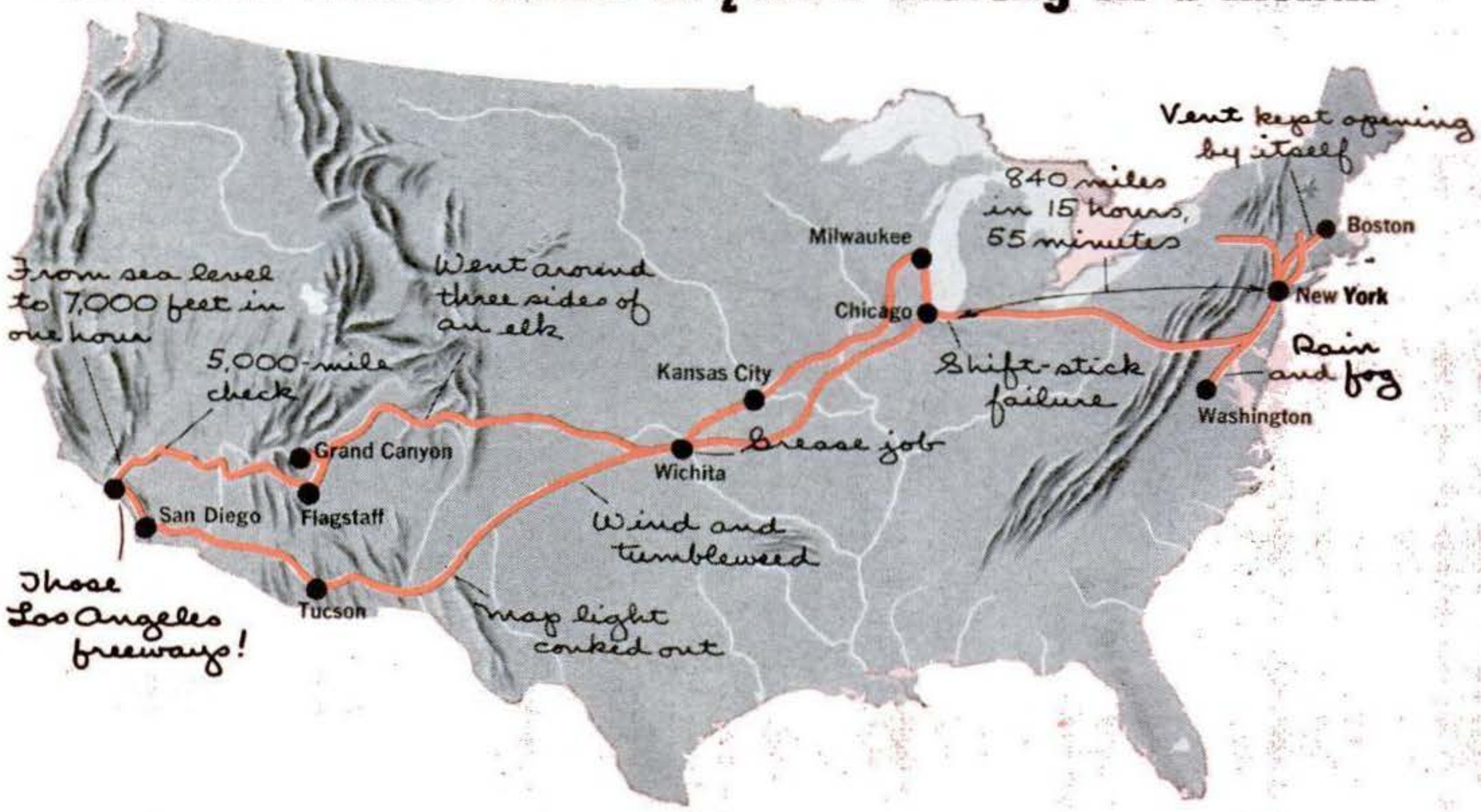
10,000 MILES IN A

On the pages that follow, POPULAR SCIENCE gives you its third complete report-from-the-driver's-seat on America's new and exciting compact cars.

In January we detailed the results of driving the Chevrolet Corvair for 10,000 miles. In February we tested the Ford Falcon for 10,000 miles. Now, after another 10,000 miles, the facts are in on the Chrysler Valiant.

How does it handle and ride? How does it perform? How well is it designed and built? Is it comfortable? Economical? What are its shortcomings? Finally, and most important, how does it compare with the Corvair and the Falcon?

FOR THE THIRD TIME: A year's driving in a month



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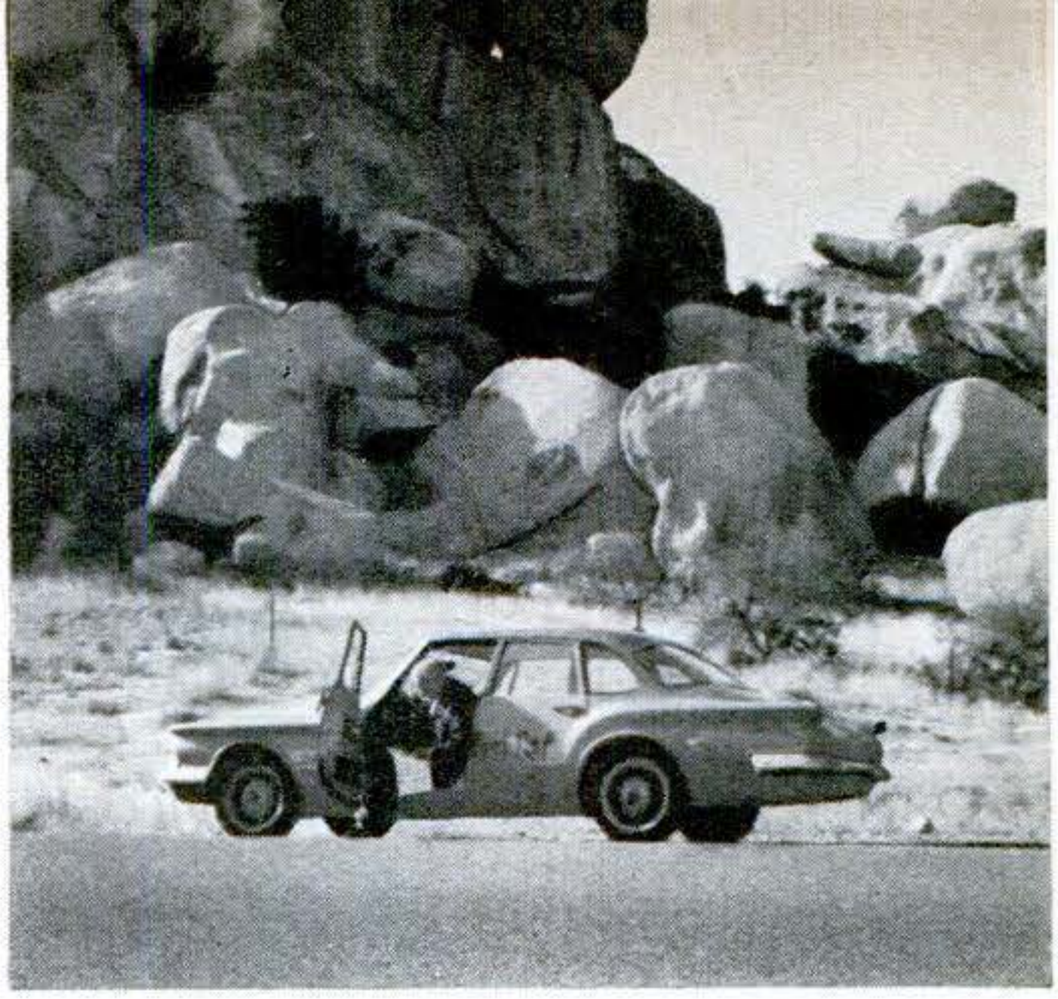
Rocks dwarfed Valiant southeast of Tucson on U.S. highway 80. The car had manual shift, was purchased retail by POPULAR SCIENCE. *Its sole accessories were a heater and front-seat belts.*



VALIANT

By Devon Francis

A GAS-PUMP jockey in a Midwest city looked incredulously at the engine of the POPULAR SCIENCE Valiant one day last December and exclaimed, "I'll be darned—a lazy six!"

This is exactly what it is not. The Valiant's spanking new six-cylinder power plant, reposing with seeming indolence on one elbow, is the most vigorous engine in any of Detroit's new compact cars.

It gives the Valiant a performance that outsparkles that of either the Corvair or the Falcon. Naturally, it puts any of the low- or medium-priced imports in the shade. It may well prove to be the new look in the new Detroit power plants.

The Valiant, of course, has its imperfections. One is serious.

Five POPULAR SCIENCE staff members and an editorial consultant drove the Valiant for more than 10,000 miles—in one month.

This panel consisted of: Howard Allaway, editor; Frank Rowsome Jr., managing editor; Hubert Luckett, technical editor; Erik Arctander, an associate editor; Henry Comstock, the consultant; and myself, a senior editor.

Our evaluations of the car—covering design, handling, ride, performance, and

HOW THE VALIANT DID

THE PERFORMANCE

Total distance covered	10,611 miles
Gasoline used (non-premium)	522.4 gal.
Average miles per gallon	20.31
Oil burned	3 qt.
Gas mileage at constant speeds	
30 m.p.h.	25.8 m.p.g.
40 m.p.h.	24.2 m.p.g.
50 m.p.h.	23.9 m.p.g.
60 m.p.h.	22.0 m.p.g.
Gas mileage in stop-and-go driving	19.6 m.p.g.
Acceleration	
0-60 m.p.h.	17 sec.
40-60 m.p.h.	10.5 sec.
50-70 m.p.h.	11 sec.
Top speed	96 m.p.h.

Speedometer error

Indicated Speed	Actual Speed
40 m.p.h.	40 m.p.h.
50 m.p.h.	49.5 m.p.h.
60 m.p.h.	58 m.p.h.
70 m.p.h.	67.5 m.p.h.

THE COSTS

Gasoline		$171.57
Oil burned		1.85
Gas-oil cost per mile		.0163
Repair and maintenance, including adjustments at 500, 1,000, 5,000, and 10,000 miles		
Oil and filter changes	$10.45	
Lubrication	6.45	
New distributor points	1.50	
Total labor	26.80	
Total		45.20
Overall direct operating cost per mile		.0206

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How Valiant Compared with Corvair and Falcon

	VALIANT	CORVAIR(*)	FALCON
Overall average miles per gallon	20.31	23.43	26.56
Gas mileage at constant speeds			
30 m.p.h.	25.8 m.p.g.	26.6 m.p.g.	30.2 m.p.g.
40 m.p.h.	24.2 m.p.g.	24.2 m.p.g.	29 m.p.g.
50 m.p.h.	23.9 m.p.g.	23.6 m.p.g.	28.1 m.p.g.
60 m.p.h.	22 m.p.g.	22.6 m.p.g.	27.1 m.p.g.
Miles per gallon in stop-and-go driving	19.6 m.p.g.	21 m.p.g.	22.4 m.p.g.
0-60 acceleration	17 sec.	17 sec.	22.9 sec.
Top speed	96 m.p.h.	88 m.p.h.	78 m.p.h.
Total oil consumption	3 qt.	4 qt.	1 qt.
Gas-oil cost per mile	$.0163	$.0145	$.0122
Overall direct operating cost per mile	$.0206	$.0184	$.0147

(*) For approximately 3,600 miles of the Corvair's 10,360, operation of the gasoline-fired heater reduced the gas mileage by slightly more than two miles per gallon.

styling—and some of our comments, are embodied in this report to you.

The Gas Economy

In summary, the POPULAR SCIENCE panel regards the Valiant as making a good showing on gas mileage, even though in most instances it could not match the Corvair or Falcon. Comstock partly dissented.

"I'll admit," he said, "that I pushed the car hard in driving coast-to-coast twice. But, even so, my average should have been better than 20.3 miles to the gallon."

Arctander commented, "That's a lot better than most U.S. cars, including some of the earlier compacts, can get."

Rowsome pointed out that the Valiant engine has a bigger displacement than either that of the Corvair or Falcon. More important, he said:

"The Valiant is hundreds of pounds heavier than the other two cars. Twenty-two miles to the gallon at a constant 60 miles an hour really isn't bad at all."

I found the Valiant spectacularly economical when compared with the bulk of Detroit's output for the last decade.

The Handling

The PS panel agreed that the Valiant was, in general, a match for the Corvair and the Falcon in roadability.

Allaway said, "It's alert. It's instantly responsive."

Arctander reported that the car behaved well in tight turns. Comstock climbed California's Mt. Lowe, taking 25-mile curves at 40 as though on rails.

Rowsome said, "The Valiant corners competently—better than the Falcon but not so well as the Corvair."

All six of us found that the steering, though precise and moderately quick, took an effort. It was harder than the Corvair's but fully as good as the Falcon's, which was noticeably slower.

The braking was firm and adequate.

Comstock reported, "I can vouch for

How Well Was It Designed and Built?

Well-designed, able, and comfortable for the most part, the POPULAR SCIENCE Valiant nonetheless had its shortcomings.

Front-wheel jounce transmitted vibration to the entire car.

Wind noise at high speed was excessive.

Rear-window view was inadequate.

The heater's blower was noisy at high speed.

Construction was indifferent:

Windshield's right side admitted rain.

Both under-dash ventilation doors latched badly and had to be wired shut.

Parking brake failed to hold on hills.

Assorted wiring dangled under panel.

Clutch linkage was rough; lubing could not remove steering-wheel squeaks.

Dome-light switch failed, was repaired twice, failed twice more.

At 5,000 miles, gearshift-lever linkage loosened, and needed repairs.

A persistent clanking was finally traced to two deck-lid torsion rods banging together.

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that. East of Durango, Col., I was doing 55 at night on U.S. 160. I kept seeing crazy skid marks on the road, and wondered what caused them. Then I found out. A bull elk trotted onto the pavement not 200 feet ahead of me. Only the brakes, in a squalling four-wheel slide, saved me."

The Valiant has good compression-braking on hills. It heels little on turns.

But Allaway remarked, "The Valiant is almost as sensitive to wind as the Falcon. It can't match the Corvair."

Comstock said hard wind blasts shook him up more in the Valiant than in the Falcon.

Rowsome added a footnote: "But give the Valiant a gold star for directional stability. It wants to go where you aim it."

I found it an excellent over-the-road vehicle.

The Ride

A majority of the panel considered the ride better than the Falcon's but not as good as the Corvair's. Drivers' wives found the ride smooth, front and back.

Arctander said, "What bothered me most was vibration. At some speeds the whole car vibrates."

Allaway found too much vibration in the steering wheel. Comstock wondered if maybe the ride was a bit soft.

Luckett said, "I've found nothing like the front suspension on the Valiant. I deliberately took two hard bumps that I had tried with the other two cars. The Corvair and the Falcon jarred my eye-teeth. The Valiant didn't know the bumps were there."

The Performance

The Valiant outpaced the Corvair and the Falcon going away.

Arctander was surprised at its acceleration. "This is a car that likes to go." He added, "And you don't have to baby it. I almost stalled out the other two cars by lugging-down. The Valiant comes down to 14 miles an hour, with two aboard, before it starts lugging."

Allaway found "all the performance I wanted." Rowsome got "good acceleration through gears."

Comstock said, "Changes in temperature and altitude apparently have little effect on the Valiant engine. I drove in

Car crossed Mississippi at Quincy, Ill., on third morning of westbound trip.

Engine stayed cool in 80-degree heat of Utah's Monument Valley.

No body squeaks developed on 100 miles of bumpy, tortuous mountain roads.

Tires were checked daily. Here it's done at White Sands National Monument.

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Valiant's luggage capacity was well nigh incredible. It held five suitcases, an overnighter, utility bag, and camera case.

The car traveled a couple of miles standing stock still—by ferry from Jamestown to Newport, R. I.

temperatures that ranged from below freezing to 80 degrees, and from sea level to 9,000 feet high. It responded the same everywhere. The car cruises, by the way, at 80 without sweat."

Luckett had nothing but praise for the engine. He found it smooth, with a lot of snap for its displacement and a surprising amount of low-end torque.

"It climbs hills like a homesick angel," he reported.

I found the performance near-perfect.

The Design and Controls

In summary, the Valiant's design is good, the controls handy and brisk.

The clutch action was as smooth as the Falcon's, far better than the Corvair's. The pedals were more comfortably placed than those of the other two cars.

Luckett commented, "The Valiant's transmission is the best three-speed box that Detroit has ever produced."

Arctander said, "I'm glad they put in an ammeter and water-temperature gauge instead of idiot lights."

Rowsome liked the instrument panel, Comstock the all-around visibility. Others of us differed with Comstock; we thought the rear window too small. Allaway couldn't detect a single squeak in the unitized body after several hours on rough roads.

The trunk size amazed everybody. To Rowsome it was "insanely capacious," compared with that of the Corvair.

The PS panel liked the pushbutton controls for the heater-defroster, the lap clearance of the steering wheel—better than the Corvair's, far better than the Falcon's—and the electric wipers.

Our magazine staff parted company with the Chrysler Corp. on some other items. Arctander was annoyed that the absence of a ring made him ferret into the deep-dish wheel for the horn button, Rowsome that the wipers had only one speed.

Comstock's wife Mary, whom he dutifully interviewed, thought the car's interior looked jerry-built. My own wife found the interior superior to the Corvair's and Falcon's.

But, she supplemented, "A lot of people are going to ask why as cheap an item as a cigarette lighter is omitted." This, like the absent horn ring and elbow rest, was because we had

Rating the New Compacts

(Consensus of drivers' records and reports after 30,000 miles of driving)

	CORVAIR	FALCON	VALIANT
Gas mileage	Second	First	Third
Performance	Second	Third	First
Ride	First	Third	Second
Handling	First	Third	Second
Design and controls	Third	Second	First
Interior space	First	Second	Third
Luggage space	Third	Second	First
Quality of assembly	Second	First	Third

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Under-dash ventilating door would not stay latched, finally was wired shut as odometer read 9,500 miles.

Collision on rain-slick pavement caused this. Repair cost: $204.25. Same repair on a Plymouth would have been $235.20.

bought the barest model that's offered.

I found the reflections from the aluminum instrument-panel frame brutal when the sun came in the rear window. As on the Falcon, a flat-entry gas filler pipe regularly caused the tank to upchuck at the pump.

The Valiant's one serious imperfection —referred to earlier—was the quality of its construction.

"The assembly-line work is bound to improve as production progresses," said Comstock. "It can't get any worse."

Comfort Factors

Generally, the Valiant compares favorably in comfort with the Corvair and the Falcon. Entrance room is better than the Corvair's, about equal to the Falcon's. The Valiant seats have less hip room than those of the other cars. But its rear leg room, while scanty, is better.

Rowsome found "almost enough" room in front for his long legs. To Arctander the head room was only just adequate.

"Say what you will," remarked Luckett, "none of these new compacts is a six-passenger automobile."

He tried three in the front seat. Even with the floor-mounted shift lever offset to the left, it was no dice. It would have been crowded, he said, even with an automatic transmission.

Only one of the six drivers, Comstock, didn't complain about the heater's marginal output.

The Styling

The PS panel split on the Valiant's styling. A bare majority found it less attractive than the Corvair but a hair more appealing than the rigidly conventional Falcon. Two members dissented. Luckett found it a delight.

Commented Arctander: "It can't make up its mind whether it's a sports car or a European sedan. And that phony spare-tire outline on the fantail!"

In Conclusion

The Chrysler Valiant is the best buy among the new compact cars if the shopping motorist's chief yardstick is snappy performance.

It takes a penalty from both the Corvair and the Falcon on gas mileage.

It compares well on handling.

Its ride, stiffer than the Corvair's but softer than the Falcon's, will please most motorists.

Complaints on shortcomings in design and controls were distributed impartially among all three cars. So were the ayes and nays on comfort factors.

As to styling, to paraphrase an old adage, beauty is where you find it.

How the Valiant's Tires Stood Up

At 10,611 miles an expert measured the Valiant's 6.50 x 13 Goodyear tires. He found that 25 percent of the tread had been worn off each of the front tires and 20 percent off each of the rear ones. The spare, switched at 5,369 miles, showed 10-percent wear. On that basis, if all five tires were rotated regularly at 5,000-mile intervals, a set should last about 40,000 miles.

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Now plastic chains

Versatile plastic is now being used for the manufacture of chains that show strength far beyond their weight.

Some advantages over steel: They resist corrosion by sea water and acids; don't conduct heat or electricity, spark if abraded, or clank.

Kettenwerke Schlieper, West German firm, has made chains successfully with ⅜- and ½-inch links. A ⅜-inch chain is shown at left suspending a 1,700-pound car. Tests are planned for chain with both larger and smaller links.

Missile TV

Ground commanders can see their missile's effect—on TV.

A complete TV-station-in-a-capsule, developed by the Army, is being inserted in the tail of a wing-mounted missile at left.

It pops out when nearing a target and transmits a close-up view, showing burst and damage, to a monitoring screen behind the line of battle.

Dry-load tank

The hose from this tank truck is not discharging petroleum, but dry cement. It could be flour or lime or any other pulverized material.

The dry-load tankers, made by Delta Tank Mfg. Co., Baton Rouge, La., are filled through top openings. Discharge power is provided by blowers.

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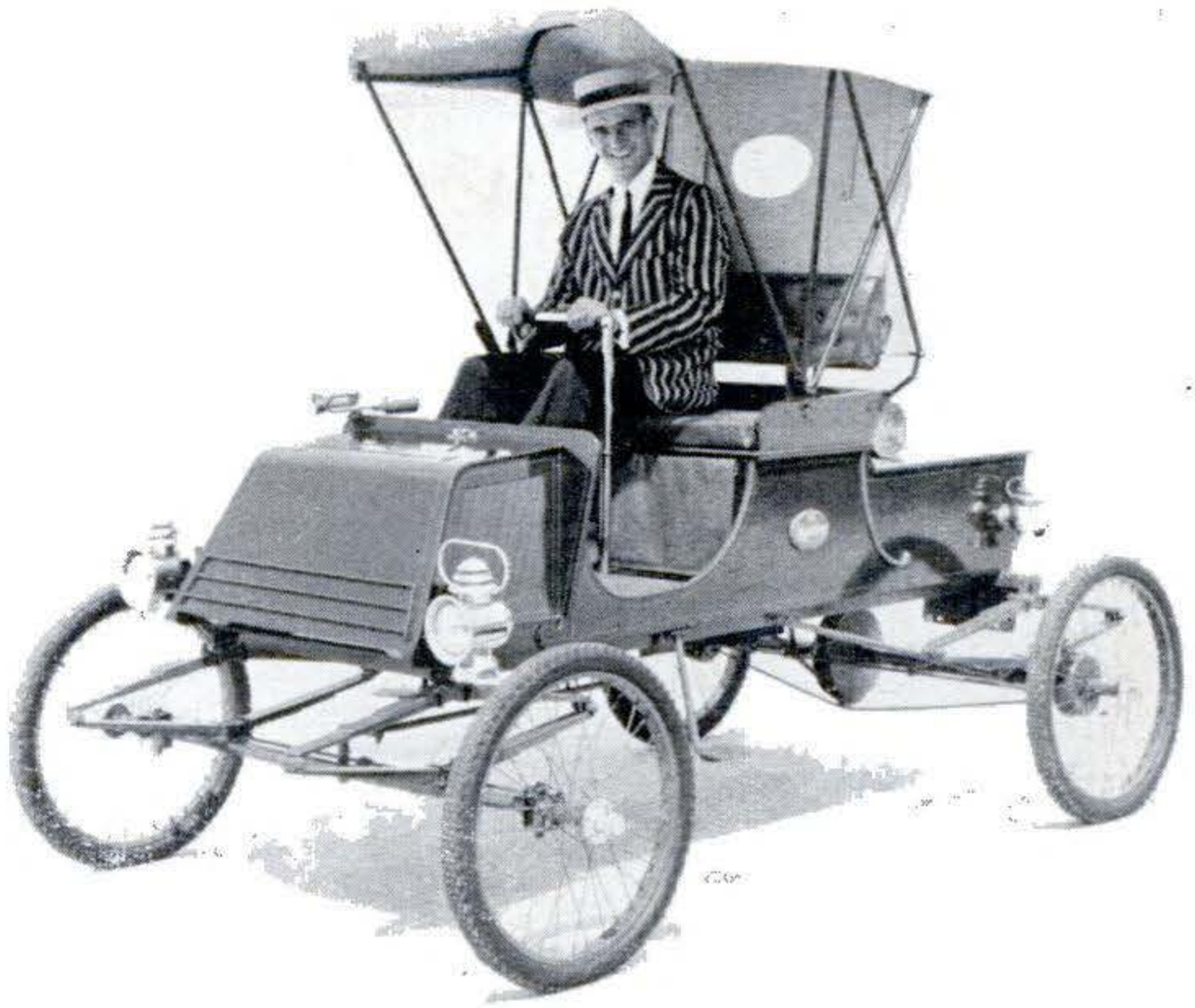
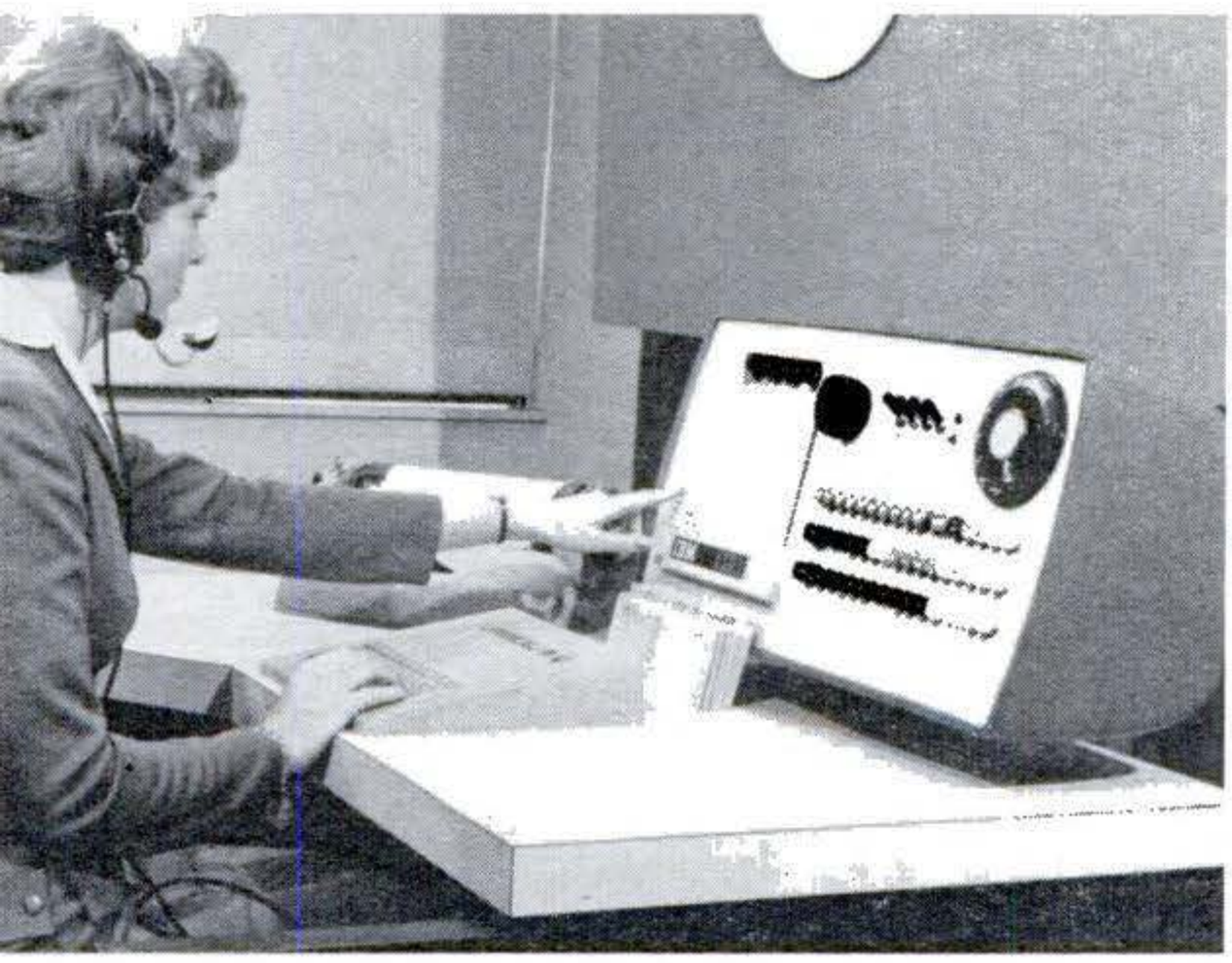
1902 car ready for '60

Here's a new car that will look familiar to oldsters. A replica of the original 1902 Rambler, it's being built for Gaslight Motors Corp., organized by three American Motors employes.

Not quite a duplicate of the first Rambler, it will have an air-cooled, one-cylinder, four-cycle engine under the seat, and an automatic clutch.

The car has a 77-in. wheelbase, reaches a top speed of 30 m.p.h., and gets 60 to 70 miles per gallon. It will be sold by Rambler dealers for around $1,500.



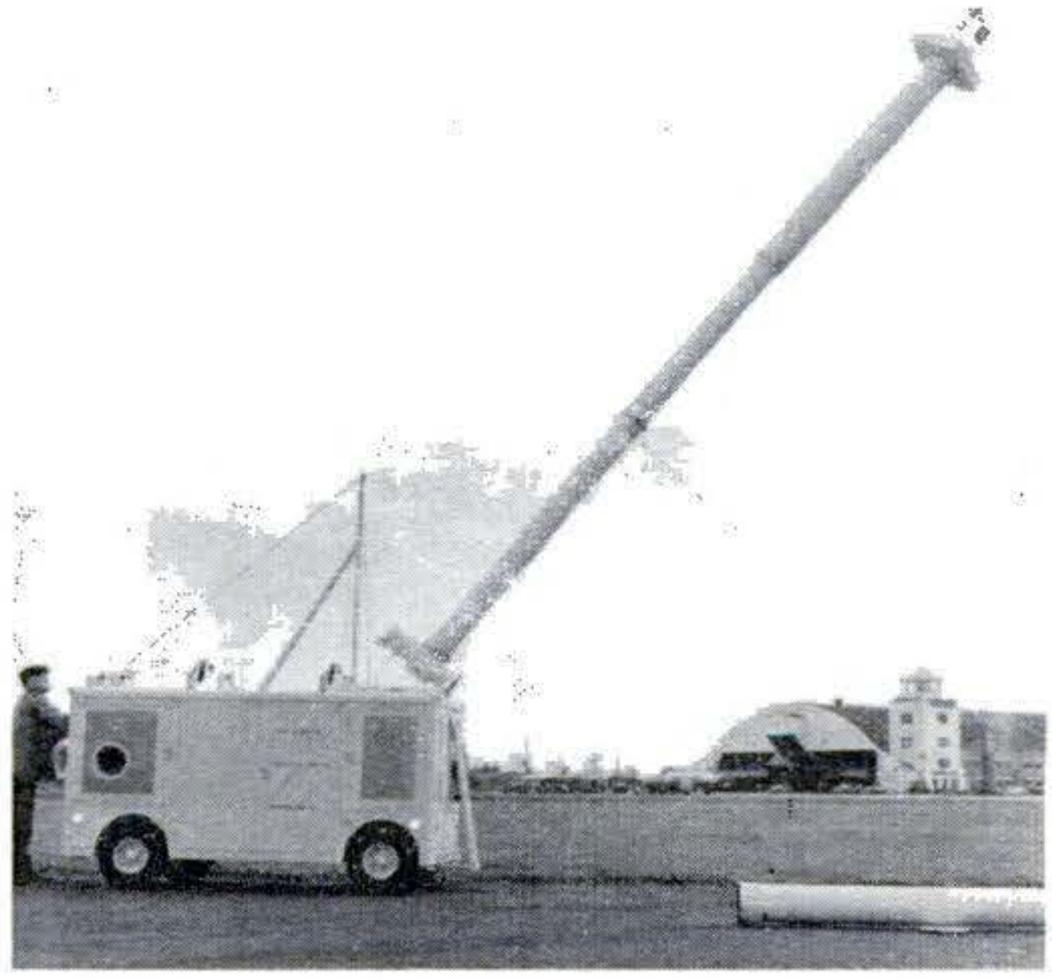


Speed-up for sky riders

Reservation desks of American Airlines in more than 60 cities will start using electronic consoles like the one shown above sometime next year.

By hitting keys, any agent throughout the country will be able to tap the electronic memory at an IBM computer center for three-second ticket transactions.

The reservations system bears the code name SABRE. Its brain will be able to gather from remote points and store 600,000,000 characters, handle more than 7,500 complete plane reservations an hour —and make no mistakes.



Robot electronic tester

When the flagpole antenna is raised on this trailer, it is ready to give a pilot on the flight line a complete 60-second check on the electronics system of his jet fighter. On a signal from the pilot, RADFAC (Radiating Facility for Aircraft Flight Line Testing) runs an electronic check on the plane's communication, identification, and navigation systems. It pinpoints any trouble.

The unit was developed by Republic Aviation for its F-105 Thunderchief. It can operate as far as two miles from the plane it is checking.

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Complete inside story from a PS correspondent in Europe on the amazing new rotary power plant:

Auto Engine Without Pistons

By David Scott

THE Germans blitzed the auto world this winter with a dream engine. Instead of pistons that shuttle up and down, it uses a tricky three-lobed rotor. A cross between the ordinary internal-combustion engine and the turbine, it promises twice the power from the same weight and size as conventional engines. The sample being fondled by the Fräulein above could drive a small car.

Besides that, it's quiet and almost vibrationless. Also, cheap to make, economical to run, and simple to maintain. It has only two main moving parts.

This potent package is a rotary gasoline engine, an engineering will-o'-the-wisp that has eluded inventors for generations. It has apparently been captured at last by the NSU Werke of Neckarsulm, Germany, makers of motorcycles, scooters, and Prinz cars. Experimental engines are already at work driving pumps. Others will power the Prinz, perhaps by 1961. The engine also looks like a hot possibility, in small sizes, for lawn mowers, outboards, chain saws, and motorbikes. Even powered roller skates may not be ridiculous. Bigger models, perhaps with rotors set in tandem, could power large cars, trucks, boats, and planes. In the U. S. Curtiss-Wright has the rights to build versions of 100 hp. and up.

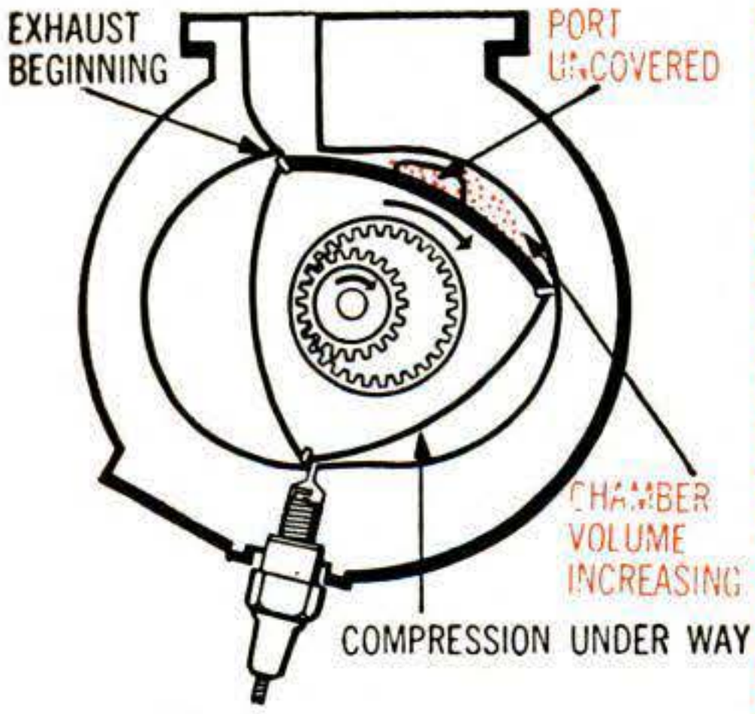
A rotor-piston. In one sense the engine does have pistons, pushed by a burning gas-air mix as in conventional gasoline engines. But the piston goes round and round, like the rotor of a turbine.

The rotor is roughly triangular. It turns eccentrically inside a wasp-waisted

CONTINUED

HOW IT WORKS: You can follow one lobe of the triangular rotor (shaded edge) through a complete Otto cycle of intake, compression, ignition, and exhaust by reading the color legends on the sequence drawings below. The black legends tell what the other lobes are doing meanwhile. In operation, one lobe follows so closely on the other that firing is almost continuous. Power is taken off by the internal gear and a mating one on the output shaft, which together provide the eccentric action. If you can't believe that this oddball rotor-chamber combination will make separate spaces of changing volume, trace the rotor on tissue paper and rotate it eccentrically clockwise over one of the drawings. It really does work.

1. INTAKE BEGINS



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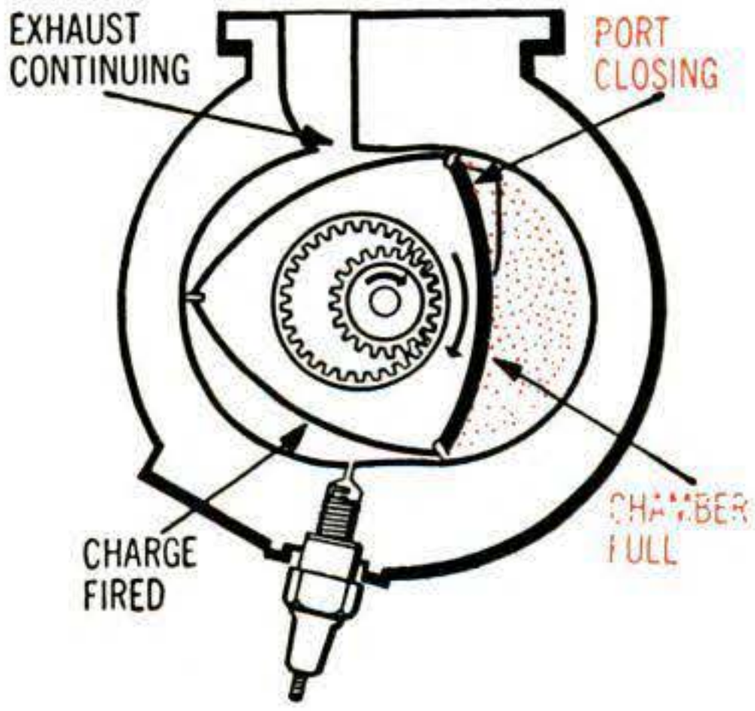
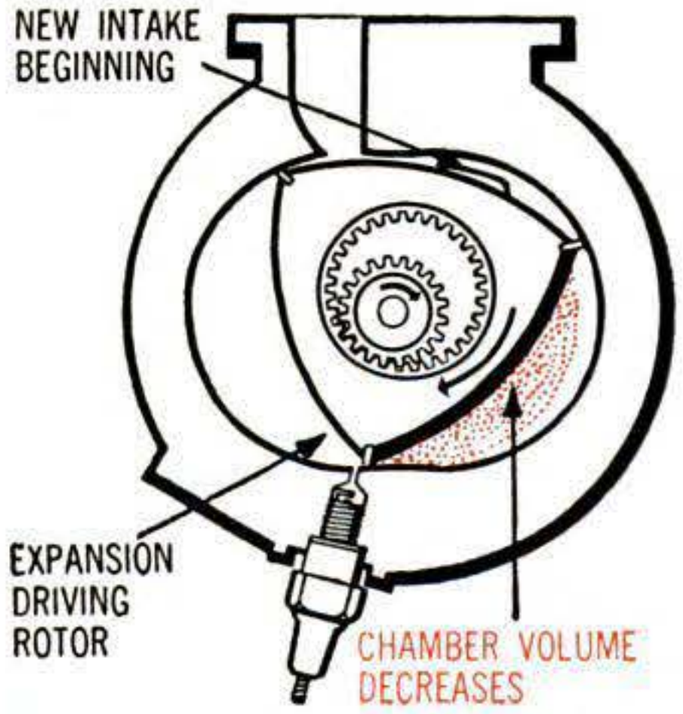


3. COMPRESSION BEGINS



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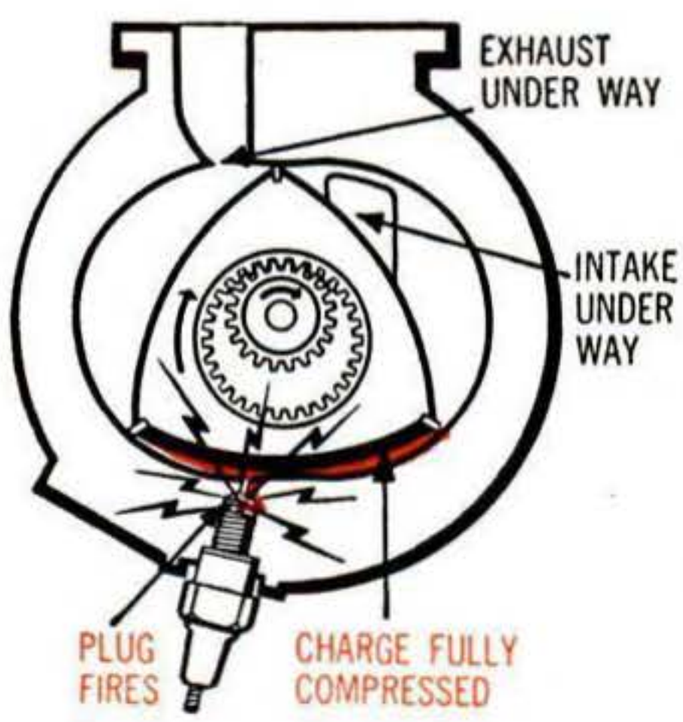
A carload of power in a handful of machinery— with just two moving parts

4.



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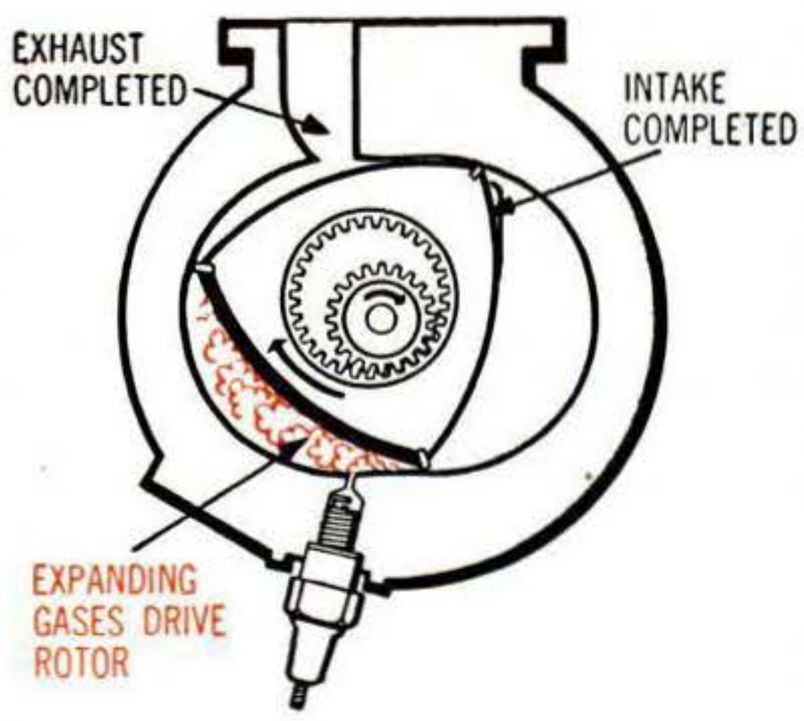
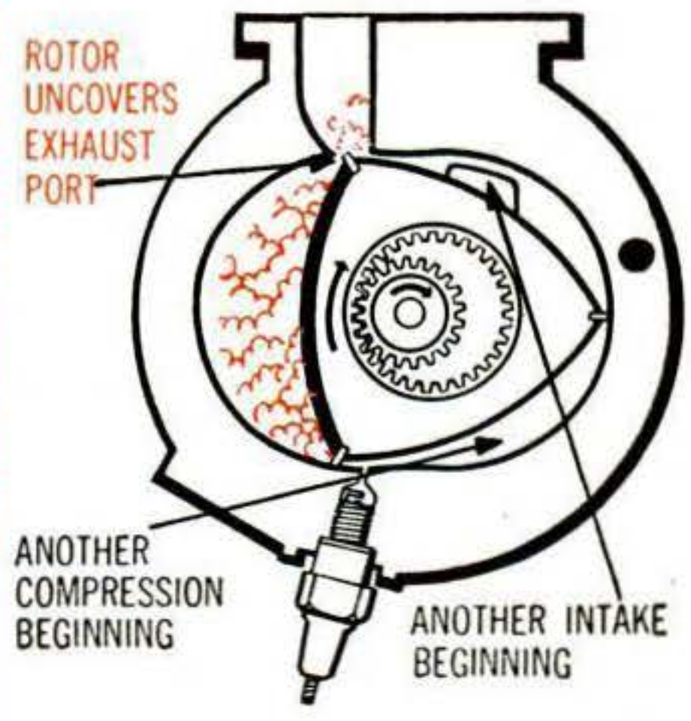


6. EXHAUST BEGINS



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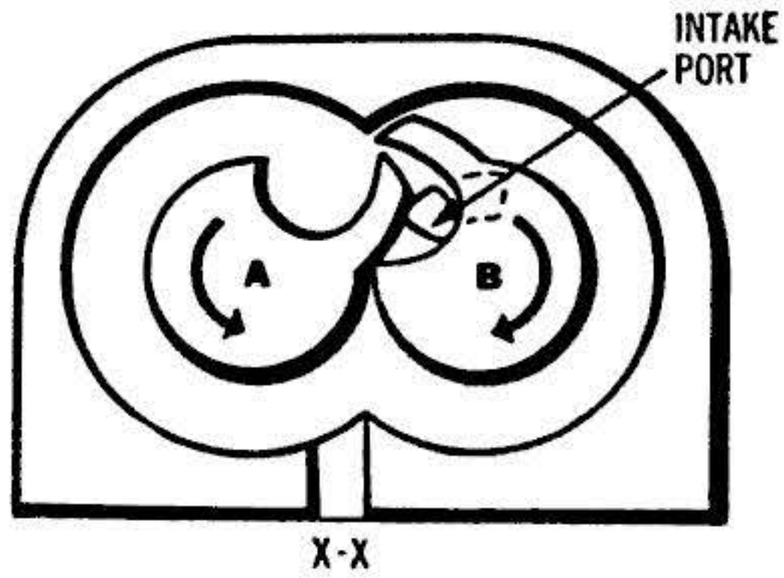
combustion chamber, its three apexes always touching the walls. This creates three moving cavities inside the combustion chamber. The three cavities constantly change size, so that the rotor first draws in fuel, then compresses it, then lets it expand after ignition, and finally exhausts. The operation is standard four-cycle although there are three power "strokes" for each revolution.

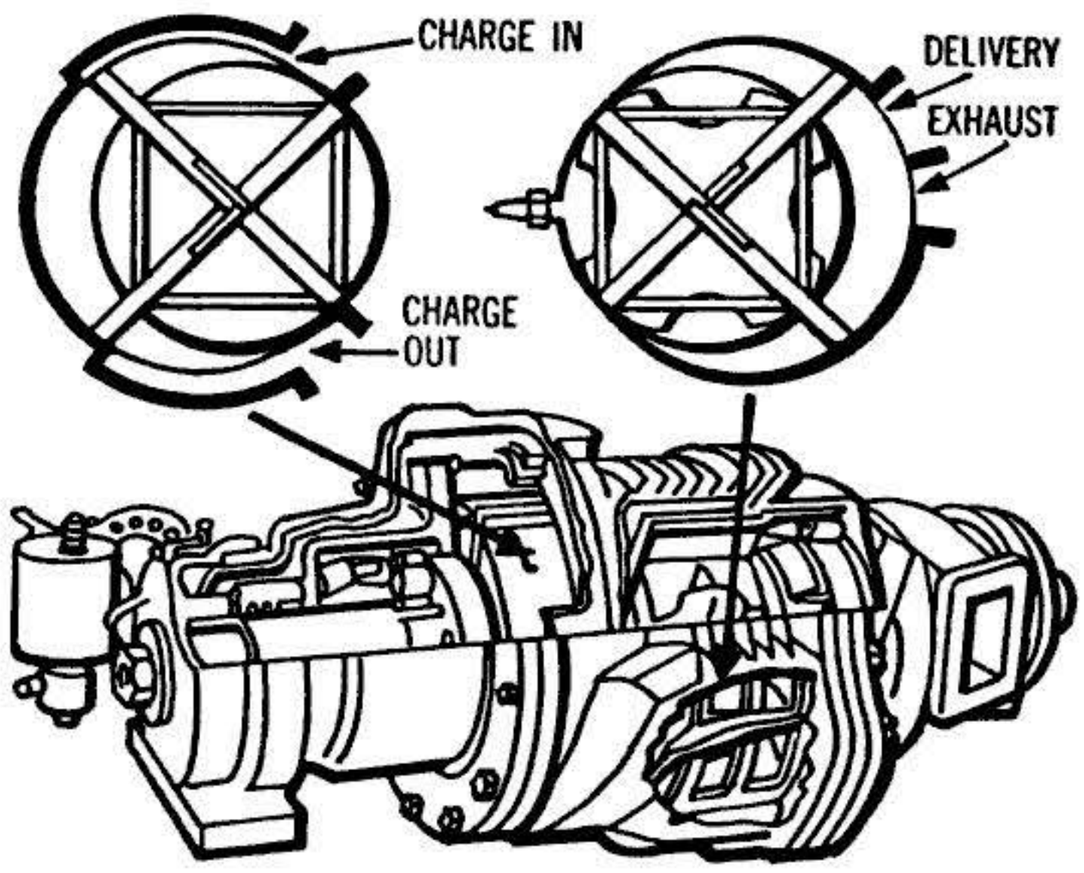
The radical design brings astonishing performance. Here's what you get:

- Concentrated power—high ratio of horsepower to displacement. NSU's first experimental engine (not the latest design) developed a phenomenal 3.8 horsepower per cubic inch. The best U. S. stock-car engine gets just over one. If you indulge in arithmetical juggling, as publicity men do, you'd find that a rotary engine the size of the mill in the 1960 Ford should blast more than 1,000 horsepower. Such theoretical scaling-up, however, is not likely to prove out.
- Very light weight. That first engine contained 1.3 pounds of metal for every horsepower it produced, and a pounds-to-power ratio of .83 is possible. Since the saving is in dead weight, you could manage the same load with a less powerful —and still lighter—engine.
- Low cost. Despite the exotic shape and fancy sealing the combustion chamber demands, NSU claims the engine is easy to mass-produce. The moving parts are simple enough—a triangular rotor and a straight output shaft.
- Economy. The rotary daintily sips fuel, consuming less than an ordinary auto engine, a little more than a diesel. For lubrication, you just add a dash of oil to the gas (2½ ounces per gallon). But the astonishing thing is the kind of gas. This engine uncomplainingly swallows fuel so crude it would gag a bus, even accepts such prehistoric stuff as 43 octane. Yet the compression ratio is high: between 7.5 and 8.5:1. The impressive resistance to knocking is basic to the design: Intake is on one side, exhaust on the other. That means incoming fuel finds no hot spots (like the exhaust valve in an ordinary engine) waiting to detonate it.
- Little vibration. The clank-bang-shake of reciprocating machinery is pleasantly absent, although turbine smoothness is not quite achieved—there's a counterweight and the off-center rotor to wiggle. But gentle operation should cut first costs —mounting is less critical—as well as upkeep expenses.
- Quiet. Rotating machines make less noise to start with, and this one also gets along without valves, which are to blame for most of an ordinary engine's roar.

These weird and wonderful rotaries didn't pan out



TWO-ROTOR ENGINE with interlocking fingers was invented in 1932 by an Australian. One experimental model was reported to have delivered 12 hp. In the position shown, a charge of fuel entered until rotation of B closed the intake port. Exhausts were apparently at x-x on the drawing. The rotors had to seal against each other.



SLIDING VANES sealed tandem rotors in Danish Larsen engine of 1935. First rotor (top left) took in fuel, delivered it to work rotor behind it, which compressed, fired, and exhausted charge. Lower drawing shows complete engine.

These two drawings based on material from the Swiss Automobil Revue

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for high power

POWER FOR THE PRINZ: Rotary engine is meant for NSU's small car, now powered by a two-cylinder OHV. Experimental rotary mill with one-fifth the displacement—7.6 cu. in. against OHV's 35 cu. in.—outpunches it, 29 hp. to 26.

NSU's rotor quietly uncovers ports, and the only sound you hear is a discreet whir-r-r.

• Responsiveness. You get most power at high r.p.m., naturally, but substantial output at low speeds—the torque curve is relatively flat. This means you'll take hills and turn corners with less downshifting, and you might get along with a simpler transmission.

However, before you rush out and tie knots in the crankshaft of your old V-8, consider the problems. There are some.

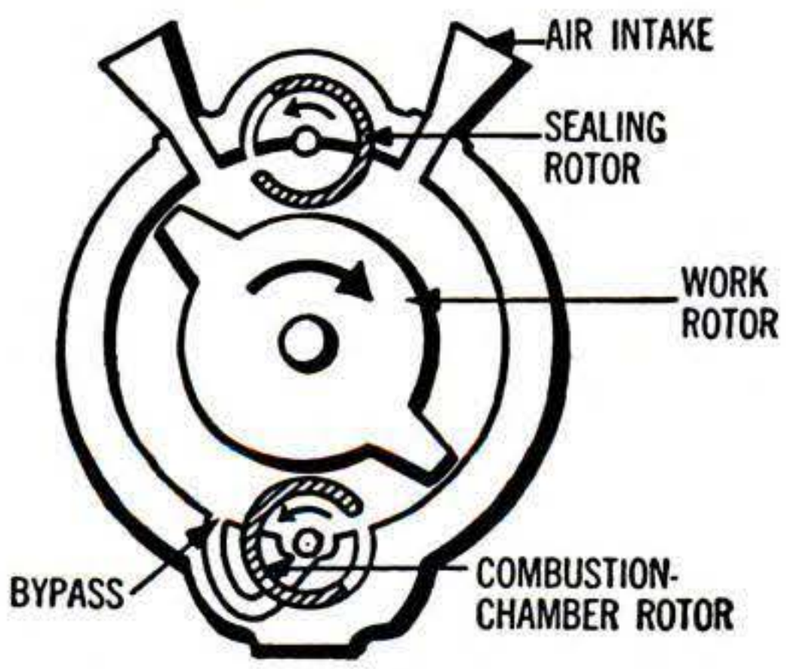
• Sealing. The combustion spaces formed by the rotor must be separate and gas-tight against an *average* pressure of 121 p.s.i. The apexes of the rotor carry sealing lips that wipe against the chamber wall. But how the sides of the rotor are sealed is not entirely clear. There are three bars, spring-loaded, projecting out from each side of the rotor. They run approximately from one apex to another, presumably parallel to the edges of the rotor. NSU does say that sealing is still a major problem.

• Cooling. The combustion chamber has a water jacket, like an ordinary cylinder. The rotor must be cooled mainly by incoming fuel, which always enters on the side away from the combustion area.

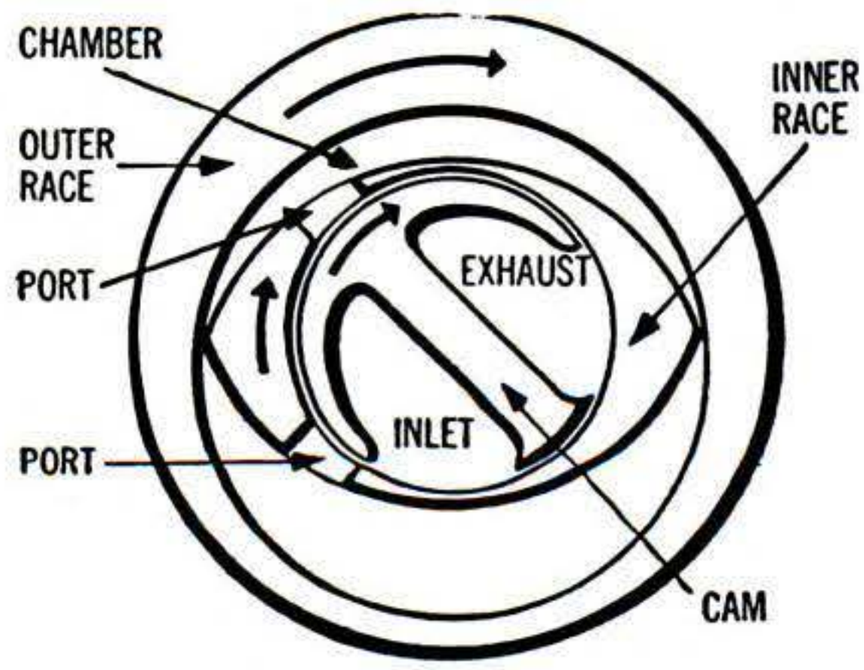
• Size limitations. Some outside engineers suspect that big versions won't equal the amazing performance of the very small (7.6-cubic-inch-displacement) prototype.

• Adaptability. NSU admits to worries about meeting the variable demands of autos, ships, and planes. Running pumps, which present a steady load, is easy.

How serious these problems are may not be known for several years of further development work. The fact is that rotary combustion engines have been built, and they work. This alone is a notable



BAYLIN ENGINE, a Canadian invention, won much attention [PS, July '46]. It had fuel injection, and made two working strokes per revolution. Small rotors sealed off intake and expansion chambers. Intake air was forced into combustion-chamber rotor. Fuel was injected and ignited as lobe of work rotor meshed with combustion rotor. High performance—one horsepower from 1.1 lb. of weight—was claimed.



EARLY VERSION OF NSU ENGINE, since abandoned by its designers, was a nightmare of spinning pieces. The outer race turned four times and the inner race twice for each revolution of the anchor-shaped valve cam. Chamber volume changed as the oval inner race swept around the eccentric cavity, while the valve cam successively uncovered ports to the two combustion chambers for intake and exhaust.

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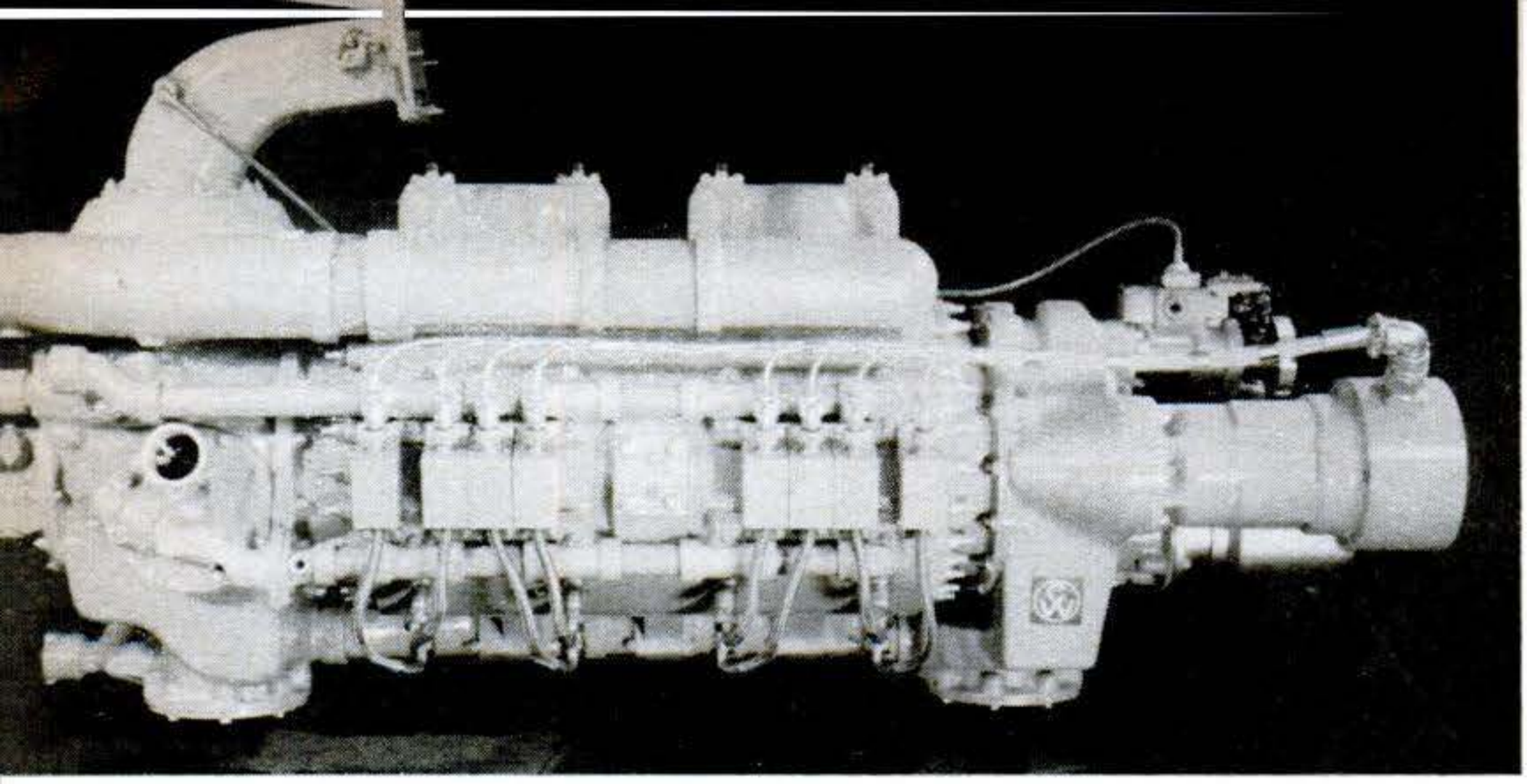

ROTARY FOR AIRPLANES: This is one of the large models of the NSU-Wankel engine being developed by Curtiss-Wright, owner of U.S. rights to the German invention. Supercharged, it presumably combines several units in tandem. C-W says it is better than a jet because it doesn't lose power as air temperature rises.

achievement, as NSU immodestly proclaims.

The beauty of a circle. Most of the rotary engine's advantages come simply from the fact that it is rotary. Right off that knocks out much of the noise, vibration, and complex gimcrackery that plague reciprocating engines. It also sidesteps a difficulty that hobbles power.

Reciprocating pistons must be brought to a dead stop at each end of their travel, then accelerated in the opposite direction. It takes energy to stop them, and to speed them up again. The stopping energy must be absorbed in the machinery —a great strain on bearings. The speeding-up energy is a drain on engine power —it never gets to the wheels.

Worst of all, these inertia losses increase in proportion to the square of engine speed. That's why reciprocating engines can't run very fast. They become inefficient and even fly apart.

Rotating parts don't stop and reverse. They can operate safely and efficiently at very high r.p.m.—and that's the most effective route to high power, much better than jacking up displacement or compression ratio. This explains how the rotary engine packs so much punch into a small package. It spins very, very fast (17,000 revs a minute in the prototype).

Up the hard way. The man who finally transformed these textbook advantages into a working machine isn't even an engine designer, strictly. He's a specialist in valves and sealing techniques: 58-year-old, bald and bespectacled Felix Wankel from the Black Forest.

Wankel started out as a book salesman, but kept plugging away at engineering in a workshop at home. Some bright ideas for sealing high-pressure lubrication systems got him out of the publishing business and into full-time research. By World War II he was a wheel in the German Aviation Research Institute, developing sliding-plate valves for aircraft.

V-E Day put Wankel back in his cellar workshop, with plenty of time to tinker. He had kicked around notions for a rotary engine for years. After all, sealing was the big problem, and he was the sealing expert.

Wankel licked that. He also worked out the tricky geometry that makes the rotor sweep changing combustion spaces.

NSU latched onto Wankel's designs in 1951, first applied them in 1956 to a compressor for a tiny but conventional motorcycle engine that set speed records on the Utah salt flats. The power plants for pumps, motorcycles, and the Prinz are still to come. Meanwhile, NSU sold rights to build larger engines to Curtiss-Wright, the U. S. air-engine firm. This led to an international foofaraw over public announcement of the great invention.

Curtiss-Wright stole NSU's thunder by revealing a few sketchy facts at a party in New York (U. S. Government officials wondered if the drum-beating was intended mainly for C-W stock, but C-W denied it.) NSU blew its collective stack, privately. Publicly, it let out details.

THE INVENTOR, Felix Wankel, started work on the rotating engine in his home workshop. A self-taught engineer but no amateur, he is one of Germany's leading experts on sealing techniques, which had been the main stumbling block to development of the rotary.

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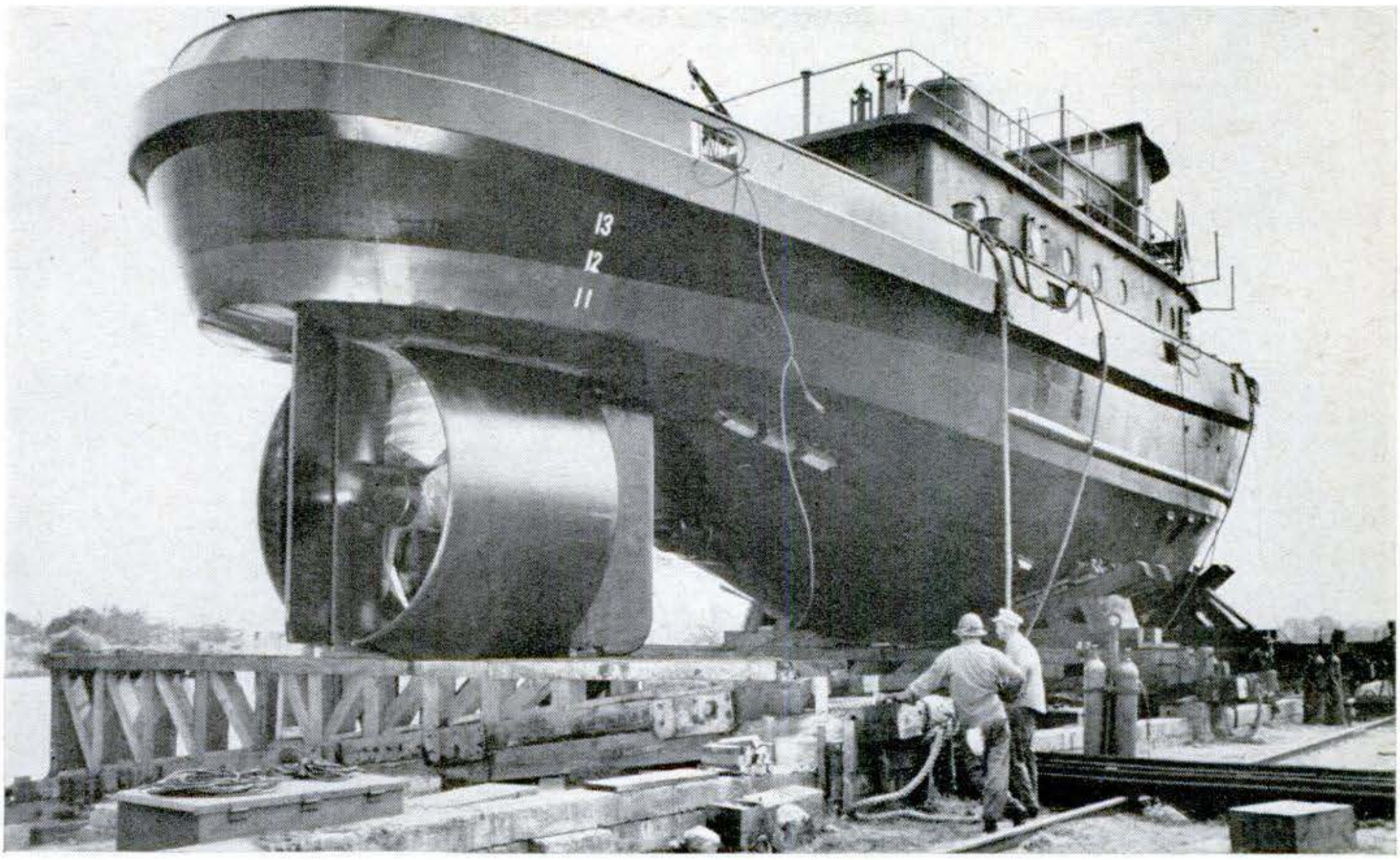


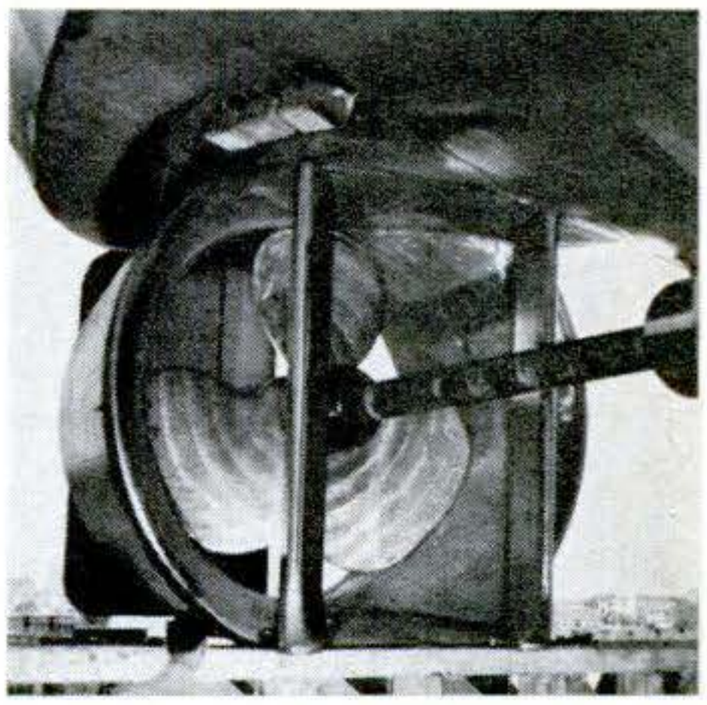
A single rudder aft of the propeller nozzle steers the Dravo Pioneer when she steams ahead.

Tunnel-prop tug has big push

The Dravo Pioneer, a recently launched tugboat, develops 20 percent more push than other harbor tugs of the same horsepower and steers as well astern as ahead.

A unique propeller-rudder combination called a Kort nozzle makes this possible. It's a short tube with a screw inside and rudders at each end. The propeller shoots water out in a jetlike stream, increasing the thrust. When moving ahead, the tug steers with its aftermost rudder; when backing, it uses the forward two. The tug thus maneuvers well in either direction because the rudder in use always turns in a moving stream.

Dalzell Towing Co. has chartered the $500,000 tug for regular towing service in New York Harbor. Dravo Corp. built the new boat in its Wilmington, Del., shipyards.



DUAL RUDDER forward of the nozzle steers when the tug is backing with reversed screw.

Portable station

This service station, including pumps, office, and rest rooms, is mounted on a steel skid. It can be loaded on a flatbed truck and hauled to its business site.

There, gasoline tanks and plumbing complete the installation. It's made by A-1 Pump and Tank Co., Houston.

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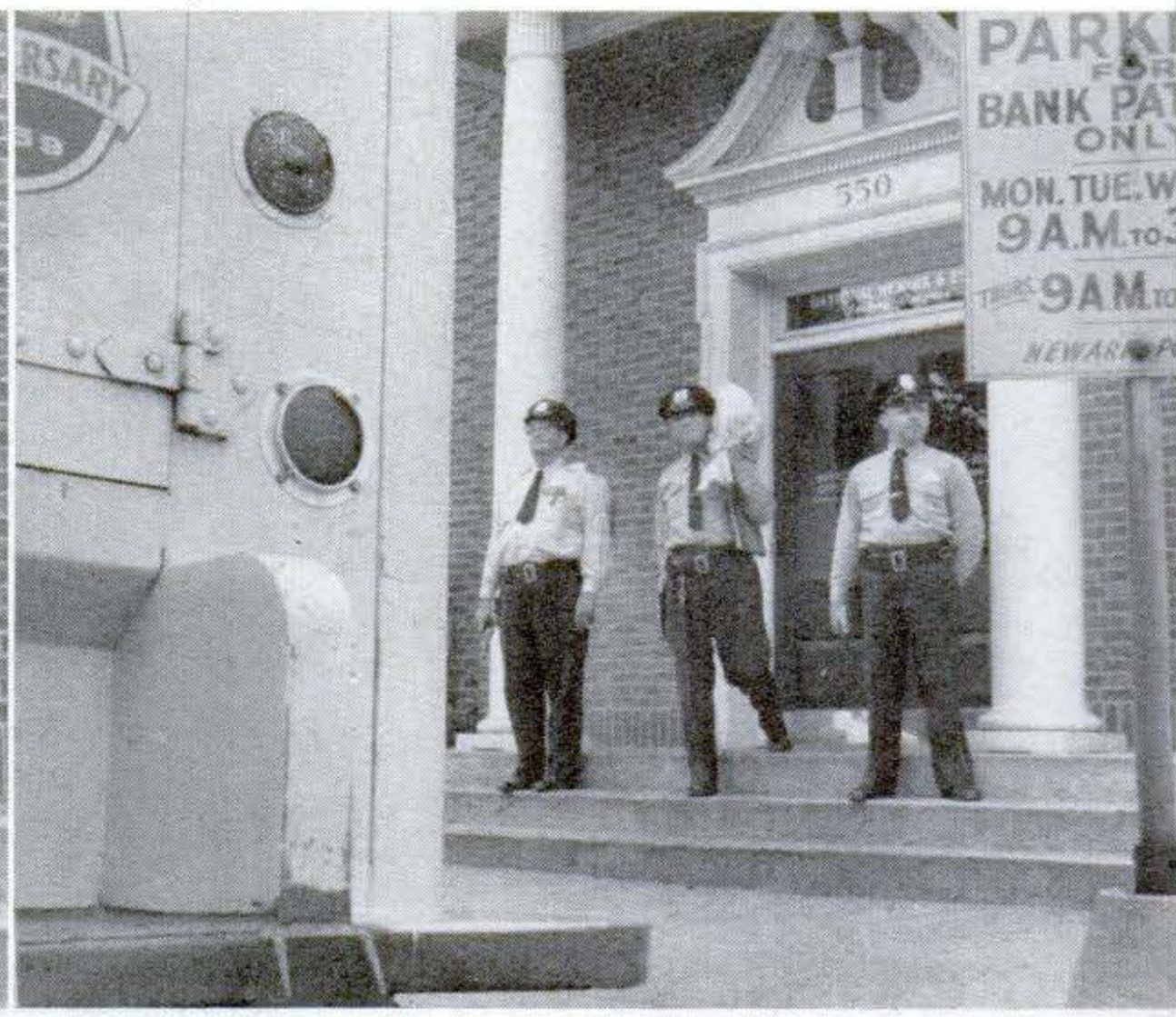
Riding with a Million in Cash

Last time a Brink's armored car was knocked off was back in 1927. Here's why the wise hijacker knows better than to try

1 READY FOR ANYTHING: Front-seat guard Felekey takes his post; driver Weiss follows.

2 HAND SIGNAL by Felekey says all's clear, so crew chief Hunt hits the pavement.

3 GUNS DRAWN, trio swings into Newark bank for a routine pickup of surplus money.



4 BAGFUL OF MONEY on his shoulder, Hunt emerges, as guards resume outdoor posts.

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By Eliot Tozer

IF YOU turned gangster tomorrow, you might well plan to knock off an armored car. In shuttling America's cash from bank to bank, armored cars often get jammed in city traffic. They bounce down country roads. They work alone; the police don't help them. They look like an easy mark.

But they are far from easy pickings, as the astonishing record of Brink's, Inc., indicates. No Brink's car has been knocked off in 33 years—and it took a land mine to bust into the last one.

Not that Brink's hasn't been held up in its 100 years as the world's biggest money mover. But every job since 1927, including the $2,500,000 Boston robbery some 10 years ago and a recent $23,900 Brooklyn stickup, was pulled off elsewhere than in an armored car. You just cannot shoot, burn, gas, or cut your way into a Brink's car in reasonable time.

5 **FOURTH MAN IN THE CREW,** vault guard Faccone lifts bag from chief's shoulder. Money collected in this tour of North Jersey banks went to New York's Federal Reserve Bank.

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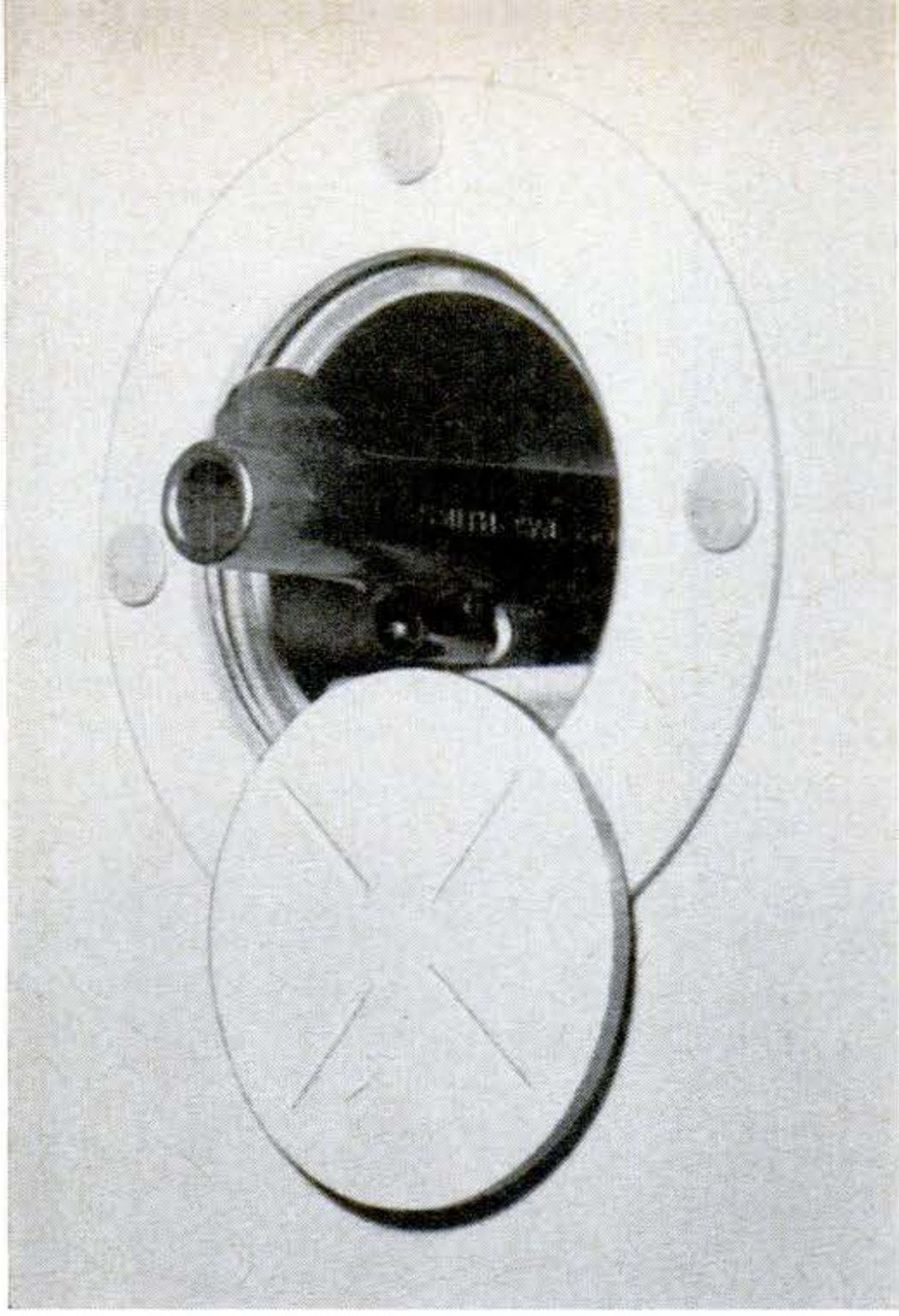

GUN PORTS on Brink's trucks are an exclusive design. When closed, port can't be budged from outside: round plate rests flush with body metal; cross destroys suction; and metal is nonmagnetic. Standard-size car has seven gun ports—two below the windshield, one under each window.

Established as an express company in Chicago in 1859 by a hardbitten ex-Vermonter, Washington P. Brink, the company today hauls only "high-liability" cargo. Most common loads are the cash and coin for banks and businesses in 2,500 U. S. and Canadian communities. Brink's' 1,000 cars pick up 1.3 billion dollars a day.

Recently I rode in a Brink's car on a "Fed" run—the first writer ever permitted by the company to have this experience. Our job was to pick up more than a million dollars in coin and bills—most of the latter in easy-to-spend fives, tens, and twenties—from banks in several New Jersey towns and deliver it to the Federal Reserve Bank of New York.

The day's work. At exactly 6:30 a.m., driver Leslie Weiss and I swung open the massive bulletproof doors of the cab and climbed onto the high step. (When closed, the door covers the step to discourage unwanted hangers-on.) The doors clanged shut and we were cut off from sounds of the outside world. Behind us in the "vault" sat the messenger (or crew chief) and two guards. We could not talk to or reach them through the thick bulkhead—with one tiny window—that separated us. This was a bank vault on wheels whose invulnerability had been paid for by the blood of good men.

Its design began on Aug. 28, 1917, as messenger Barton Allen stepped out of a touring car with a $9,100 payroll for Winslow Bros. in Chicago. A bandit drilled him in the stomach. A second thug forced the guard from the car, and a third dropped the driver with a single shot. They fled with the loot.

Brink's countered by bolting steel panels to the sides and roof of every car.

But they had more to learn. In March, 1927, Paul Jawarski timed the weekly movement of an armored car from Pittsburgh to the Terminal Coal Co. at Coverdale, Pa. Then he mined two sections of its lonely route with lengths of pipe crammed with explosive.

On March 11, Jawarski and eight henchmen cut the phone wires of the only nearby house. As the three-ton armored car rumbled over the first mine, they threw a switch. The explosion tossed the car into the air. It landed upside down. The gang smashed through the floor and scrambled off with $104,000.

Some changes made. Brink's redesigned its cars again. Out went wooden floors and frames. In went all-steel frames and steel floors. Frames of today's juggernauts are half-inch cold-rolled steel. Outside panels are 12-gauge, high-carbon steel; inner panels are 18-gauge sheet with a stuffing of fiber-glass between. The result is a car that can be blown open only by an antitank weapon.

The bodies are built to last indefinitely, which is why you often see old-fashioned, narrow bodies squatting on today's wider chassis. To support the steamroller that I rode, Brink's mechanics took a Ford F-600 chassis (Brink's buys Ford, Chevy, GMC, and International chassis) and fishplated its frame with steel beams for added strength. Final all-up weight, complete with custom-built body, is 11,000 lb. With a million bucks in the back end, of which, say, $150,000 is coin, she rocks the scales at more than 20,000 lb.

To crew these $13,000 custom jobs, it takes a special breed of men—quick, cool, and tough. Men like Edgar Buzzo, who broke up a robbery at Wilson & Co. on March 22, 1935. When one of five ban-

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dits ordered him to hand over the payroll, Buzzo said "Here," and shoved it into his hands. As the surprised bandit stepped back, both hands full, Buzzo shot him in the shoulder. The others fled. For this direct hit, Buzzo got the standard company award of $1,000. Had he made the kill, he'd have gotten $2,000.

No bankers' hours. At 6:32 a.m., the bulletproof doors of Brink's Newark garage rolled up and Leslie Weiss gentled the heavyweight vehicle into the street. With five speeds and a dual axle at command, he ignored the truck lane. "We drive 'em like passenger cars," he said.

"How fast will she go?" I asked.

"We keep it below 50," he said. "We don't need speed."

His implication was that he would prefer to stand and slug it out. Like all Brink's crewmen, he wore a .38 cal. Police Special low on his hip.

Weiss told me that the engine was a standard 178-hp. job with four-barrel carburetor. But because it is never shut off on a run—it idles all the time the crew is in a bank—Brink's installs Fram crankcase ventilators to cut sludge. Heavy-duty batteries and a special 90-amp generator drive the siren, blowers, heaters, and interior lights. Clutch, brakes, and radiator are also heavy-duty.

"How many miles per gallon do you get?" I asked.

Weiss grinned. "About seven."

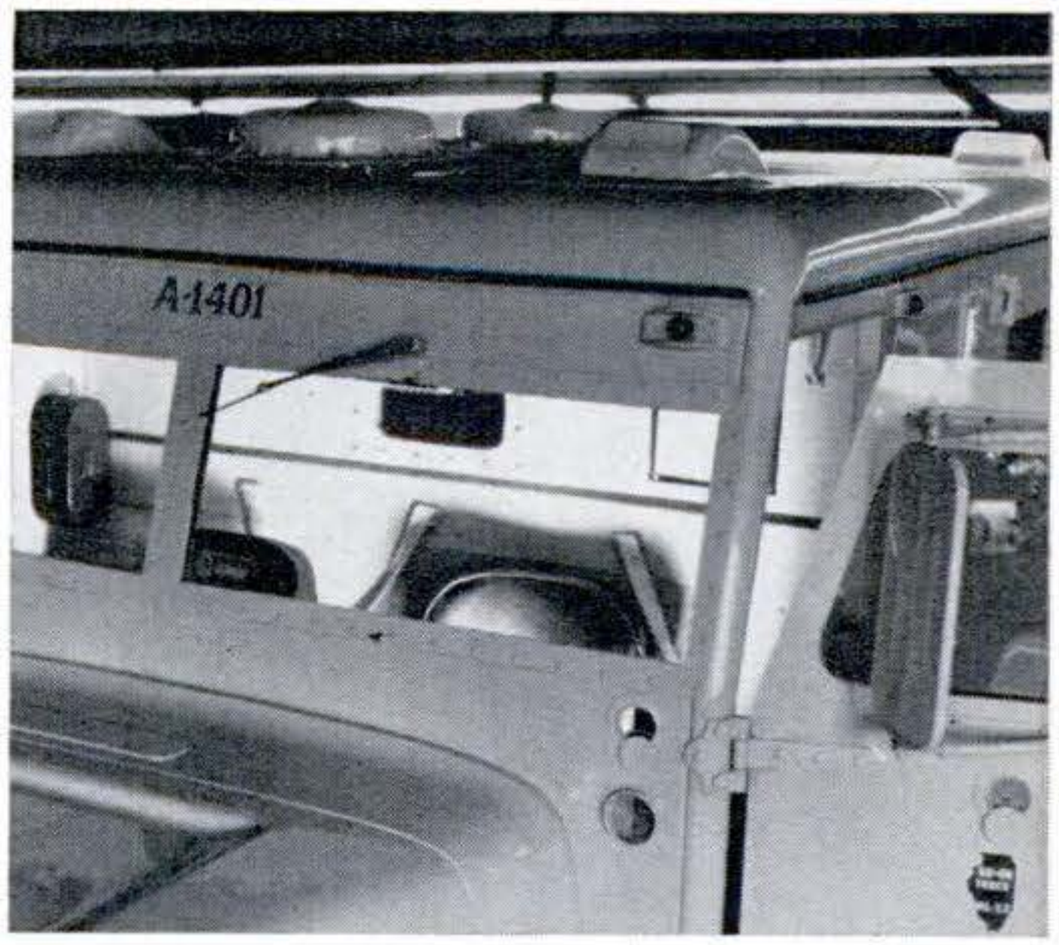
Just before our first stop, Norman Hunt, the crew chief, thumbed a button in the back end and a buzzer rasped in the cab. We stopped. "From now on," Hunt said, "you'll have to sit in back with me and Faccone."

View from the rear. There are three rearward-facing seats in the back end. From these the messenger and guards watch cars that trail them. If they "pick up a bogey"—one that hangs around too long—they telephone ahead to police.

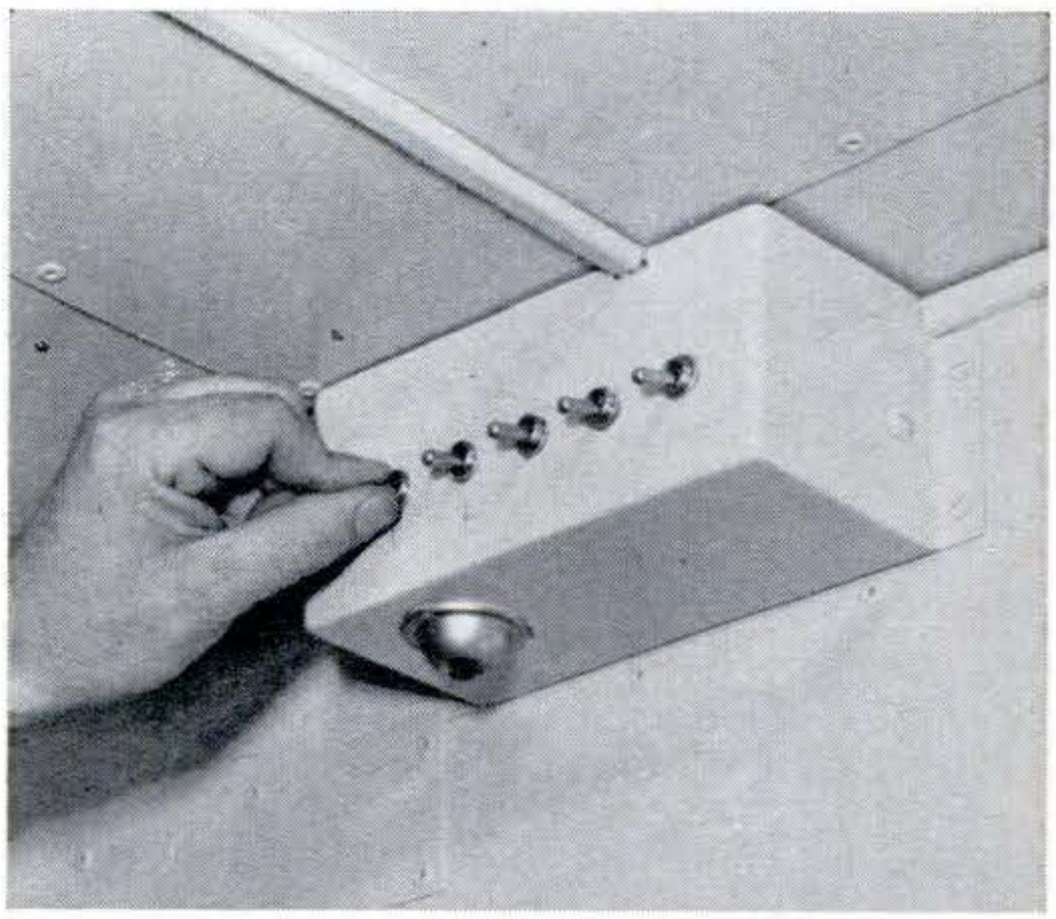
We were almost directly in front of the bank now. Through the thick side windows of the "vault" I watched front-seat guard Alex Felekey look up and down the street, then step out smartly, drawing his .38 as he hit the pavement. He pointed it straight down, the barrel close to his leg, his finger on the trigger.

This was a critical moment. He was in No Man's Land between the protective

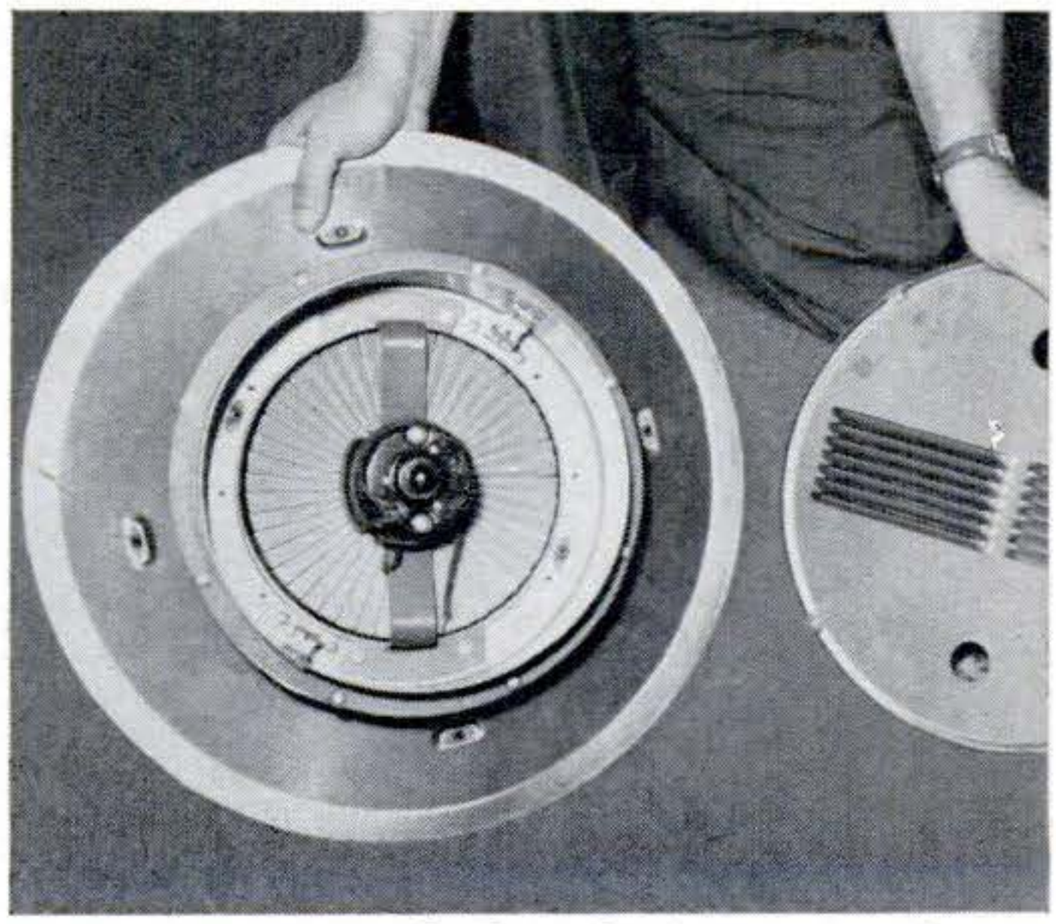
[Continued on page 246]



BULLETPROOF BULKHEAD behind seats plays a dual role. It opens up, providing sleeping berths for two on long-distance nonstop runs.



CONTROL SWITCHES enable a man in the rear compartment to cut the motor, sound a siren, and transmit signals in code to the men up front.



FRESH AIR is supplied to both front and rear compartments by fans in the roof. Each compartment also is equipped with two exhaust fans.

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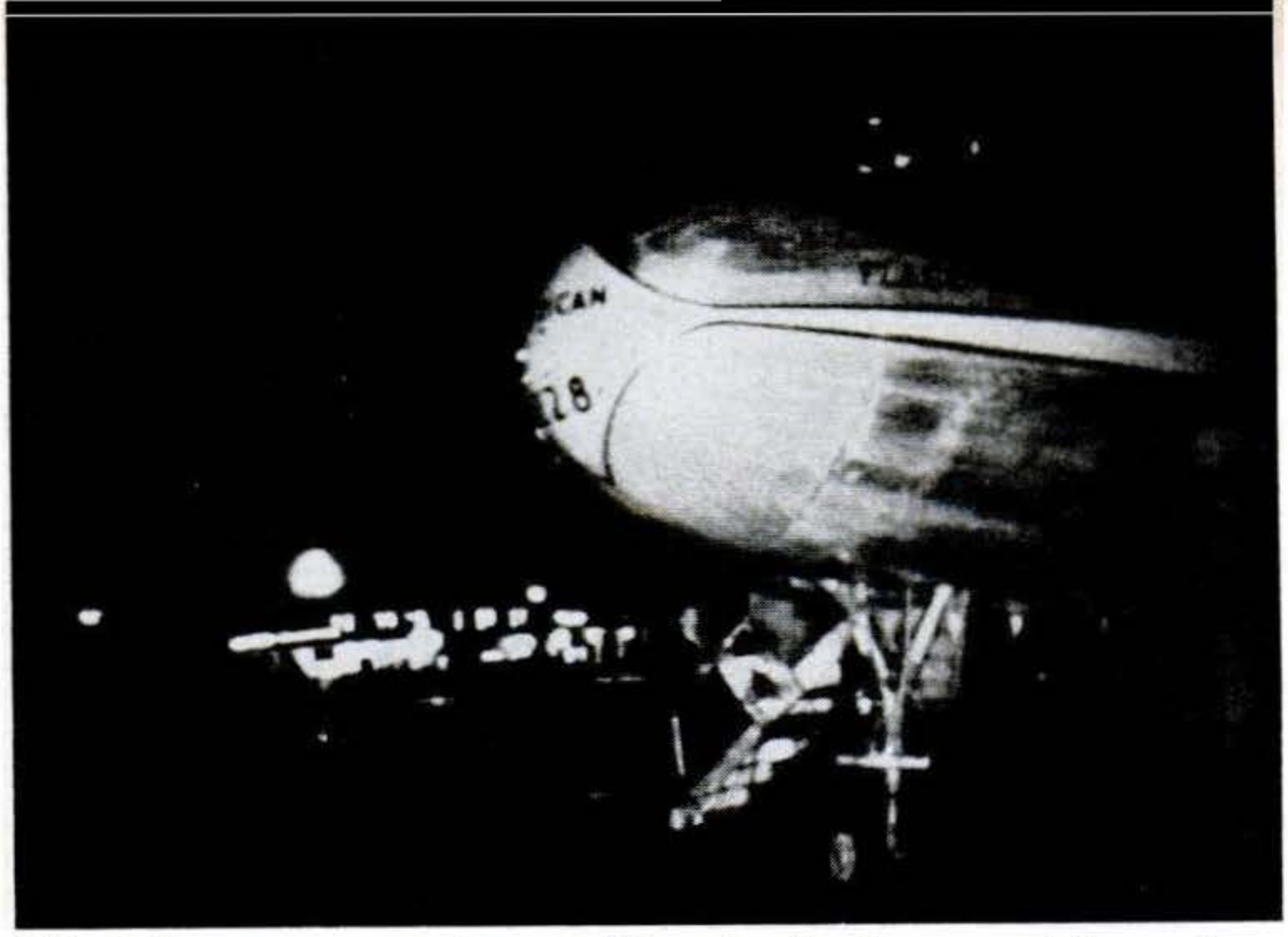
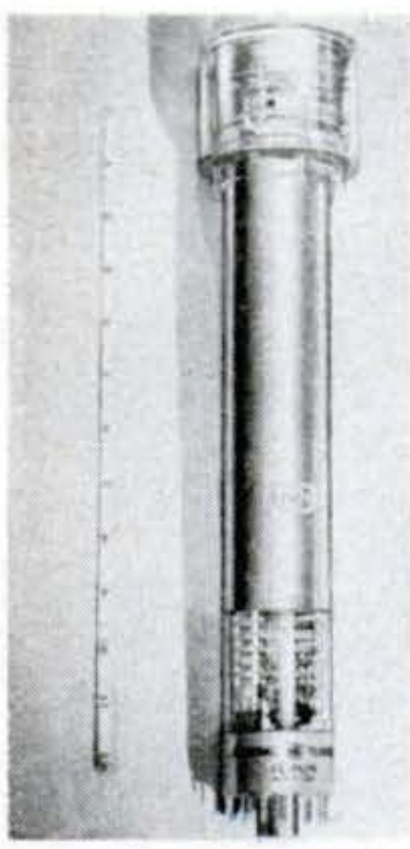


TV night scene at an airport with a standard camera tube and . . .

. . . with the new camera tube. Gain in sensitivity is tremendous.

New tube brightens TV picture



Here's what the tube looks like.

A new TV camera tube that sees with only one-tenth the light needed by standard tubes is demonstrated by the two pictures above. According to General Electric, the manufacturer, the new super-sensitive tube will radically extend the general use of color TV as well as widen the scope of black and white.

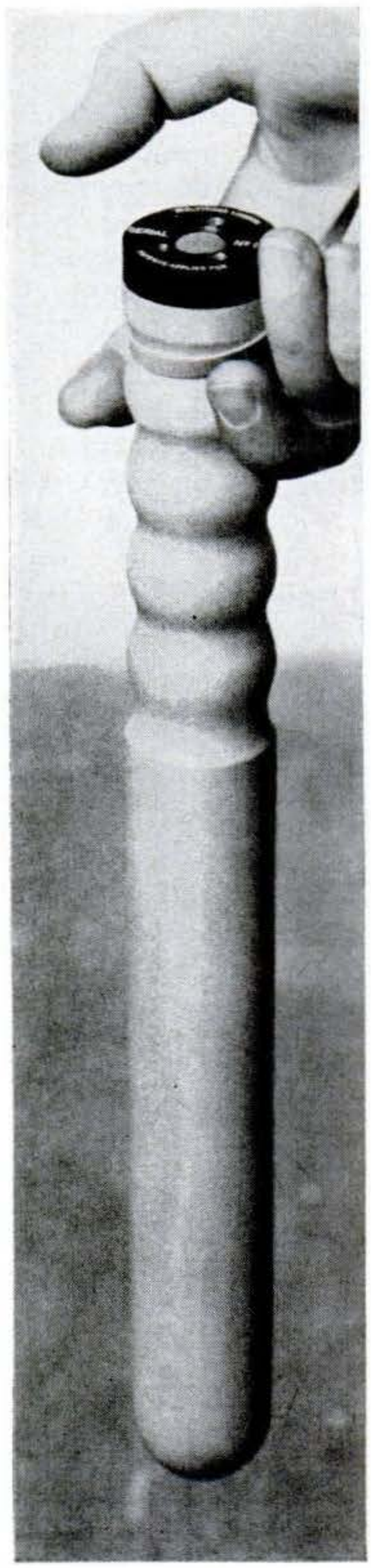
A thin-film "target"—that's the element that converts the light image to an electronic image—accounts for the extreme sensitivity. Only two millionths of an inch thick, it is said to eliminate "stickiness" (the tendency of an image of a previous scene to smear over the new one) and "burn-in" (a permanent after-image acquired if the camera is aimed at a bright stationary highlight).

Night stick

Watchmen in England now can call for help by radio without warning an intruder.

Inside the club below is a transistorized transmitter powered by a battery.

Touching the button on the end of the stick sends a signal to a tuned-in police station or a plant security office.



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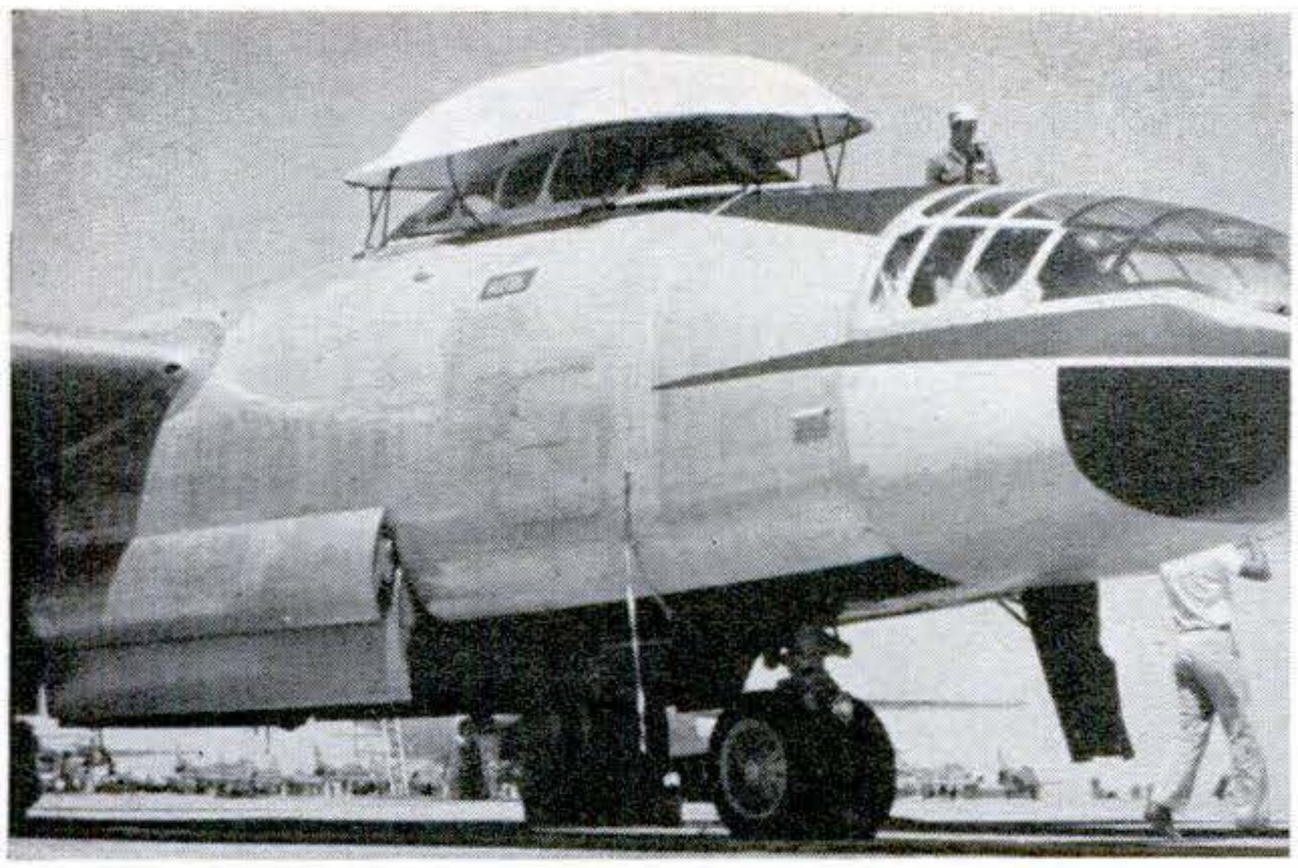
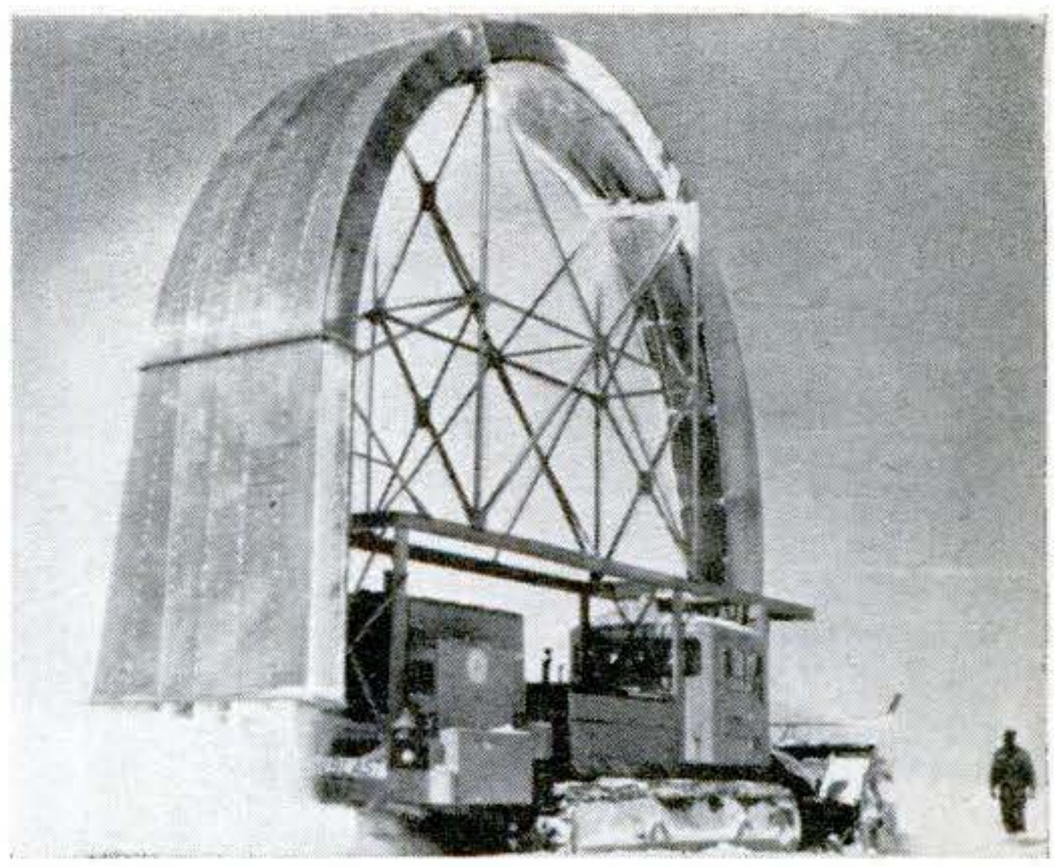


Cockpit umbrella

The saucer-shaped disk on top of this B-45 jet bomber looks like a radar, but it is not. It was rigged up by the aircrew as a parasol to keep from being baked by the Yuma, Ariz., desert sun while waiting to tow targets aloft during an Air Force aerial gunnery meet.

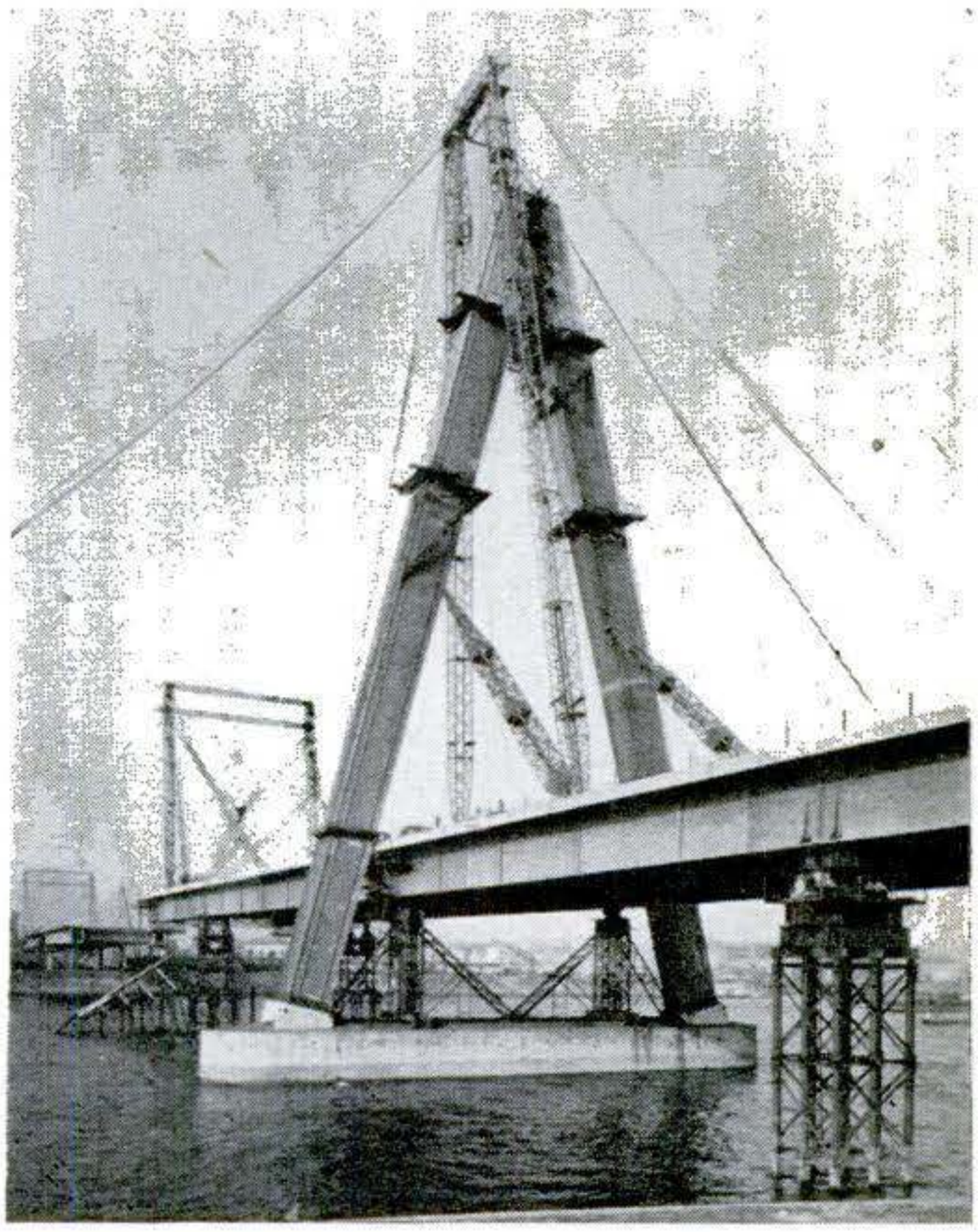


Up, over, and back down

The giant machine above is packing snow for an aircraft runway in the Arctic where it is being tried out by U. S. Army Engineers. Traveling on treads, it sucks up freshly fallen snow, powders it in the big loop, and redeposits it behind in a smooth, compact surface.

Electronic lifeguard

Vibrations occurring when a child or a pet falls into a swimming pool sound a new alarm. The sensing device is submerged, and the alarm box installed at the edge of the pool or at a distance. The sensing element can be adjusted so finely that it will pick up the splash of a hand, relay a signal to the alarm box. It is made by Minneapolis-Honeywell.



Single-tower bridge

The newest bridge across the Rhine at Cologne, West Germany, has its main center span suspended from a single A-shaped pylon near one bank. The 996-foot section is supported by cables from the 255-foot tower. City fathers of Cologne felt that more than one pylon would rival the twin spires of their famous Gothic cathedral half a mile down river.

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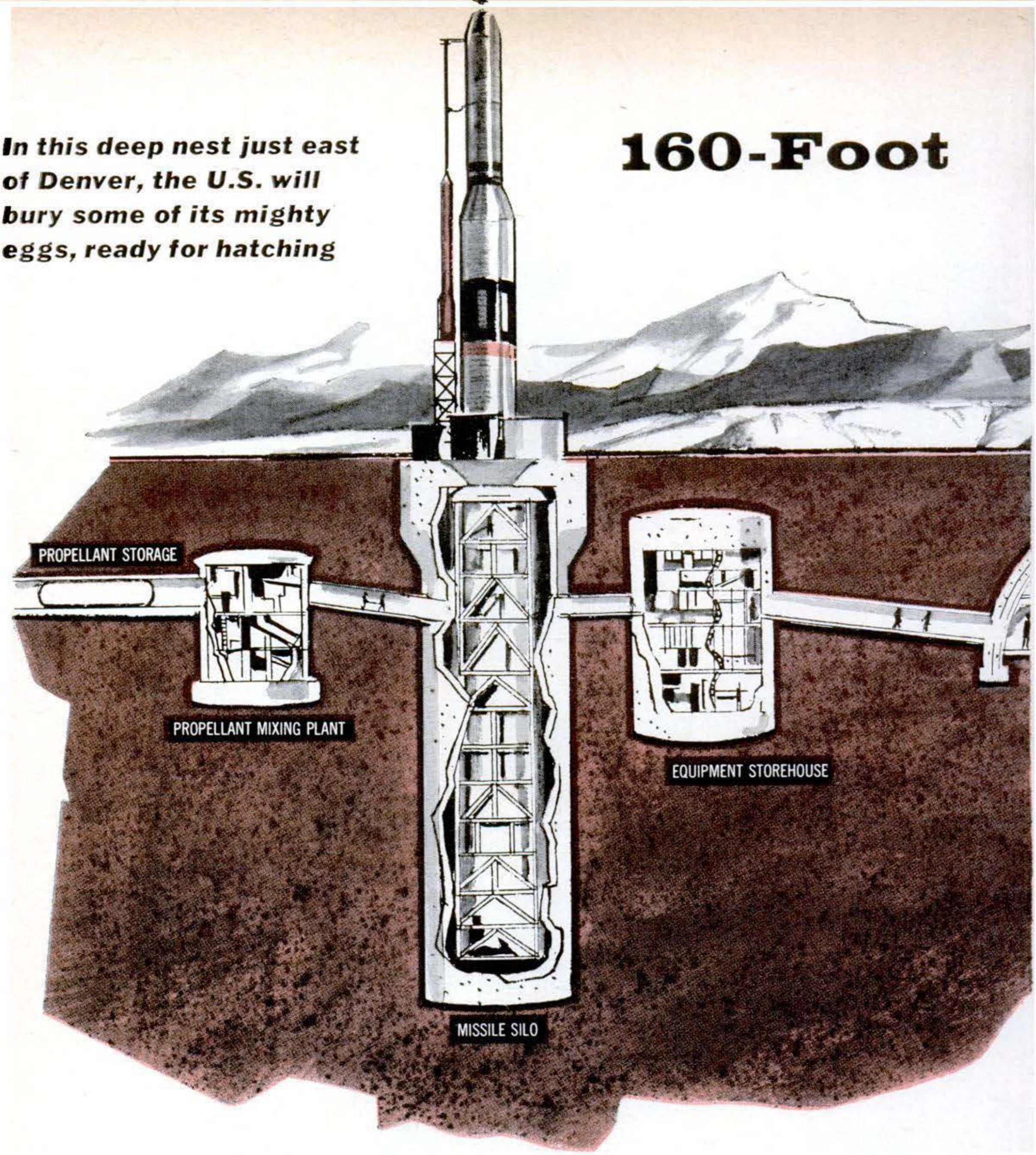
160-Foot

In this deep nest just east of Denver, the U.S. will bury some of its mighty eggs, ready for hatching



THE U. S. is starting to hide its deadliest weapons underground for safekeeping and constant readiness.

The first buried launching sites for our longest-range ballistic missiles are now being built, 40 feet below prairie level, in eastern Colorado. On six sunken plots of earth widely dispersed around Lowry Air Force Base, workmen are constructing thermonuclear armories. Circular concrete control centers and power plants, looking like great igloos, are being erected. Holes 120 feet deep and 40 feet wide are being dug and thickly lined with concrete. They'll be made deeper with huge collars of concrete, 40 feet high and up to eight feet thick. Doors of steel and concrete, three feet thick, will stopper the holes, called silos.

When the launching sites are finished, they'll be completely buried. The silo doors will be level with the prairie. It will look empty and harmless again. But, underneath it, 18 Titan missiles with H-bomb warheads will stand in the silos, in perpetual firing position. They will be ready for quick, crushing retaliation in case of attack.

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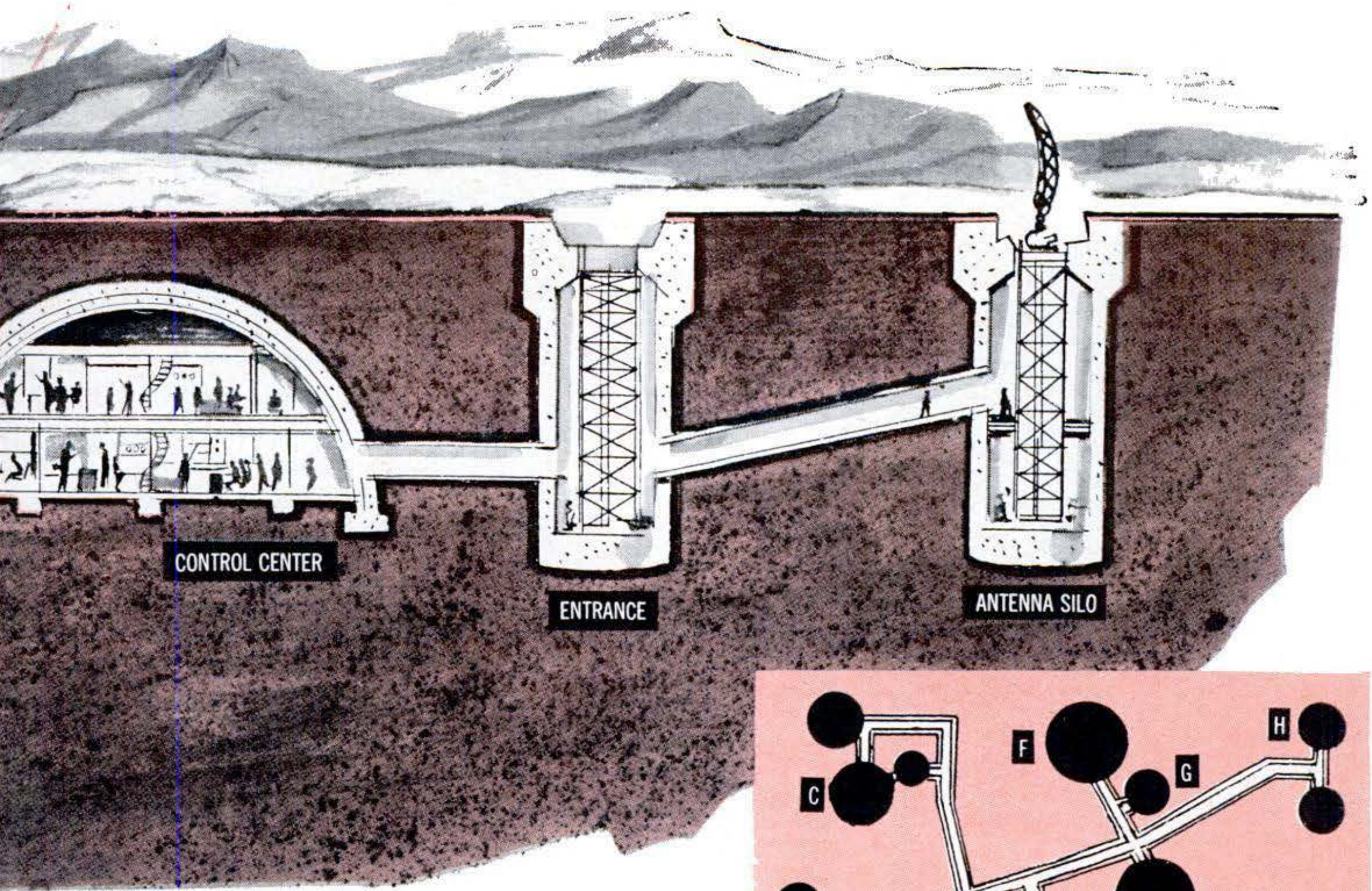
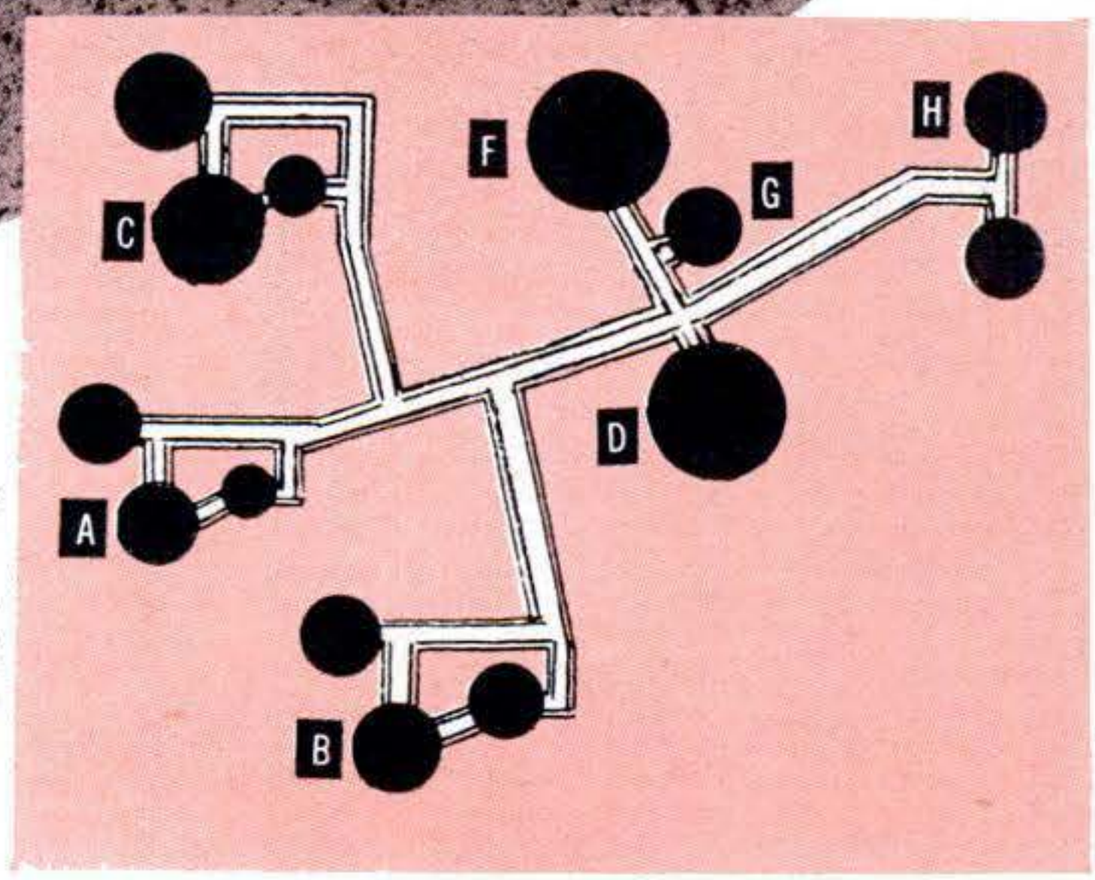
Hole in Prairie Hides Titan Missile





"HARD" MISSILE BASE may have any number of underground launching sites, or complexes. Each site contains three missile silos with auxiliary units. They are laid out as in the plan at right. A, B, and C are missile silos, with propellant and equipment terminals; D, power plant; E, control center; F, entrance; G and H, antenna silos for missile guidance at start of flight.

Other bases coming. This Colorado base is but one of 11 of the same type that the Air Force has under way. Nine more are expected to be started soon. All will be for Titans or Atlases. When the simpler, solid-fuel Minuteman is ready, perhaps two years from now, 2,600 of them will have similar holes in the ground, it is reported.

The process of constructing an underground missile base is called "hardening" it. The purpose is both to hide it and to protect it from enemy missiles. A typical hard base is depicted above.

These bases must be built as fast as possible. So Morrison-Knudsen Co., Inc., & Associates, who have the contract for the Lowry job, decided to use a "cut-and-cover" technique. This meant first sending in squadrons of bulldozers to strip off the top 40 feet of soil at each launching site. In the huge, broad trenches that resulted, the necessary structures can be built largely in the open. Further excavation, except for the missile silos, has been kept to a minimum. The silo holes have been dug by the bulldozers, snorting around in circles with 40-foot diam-

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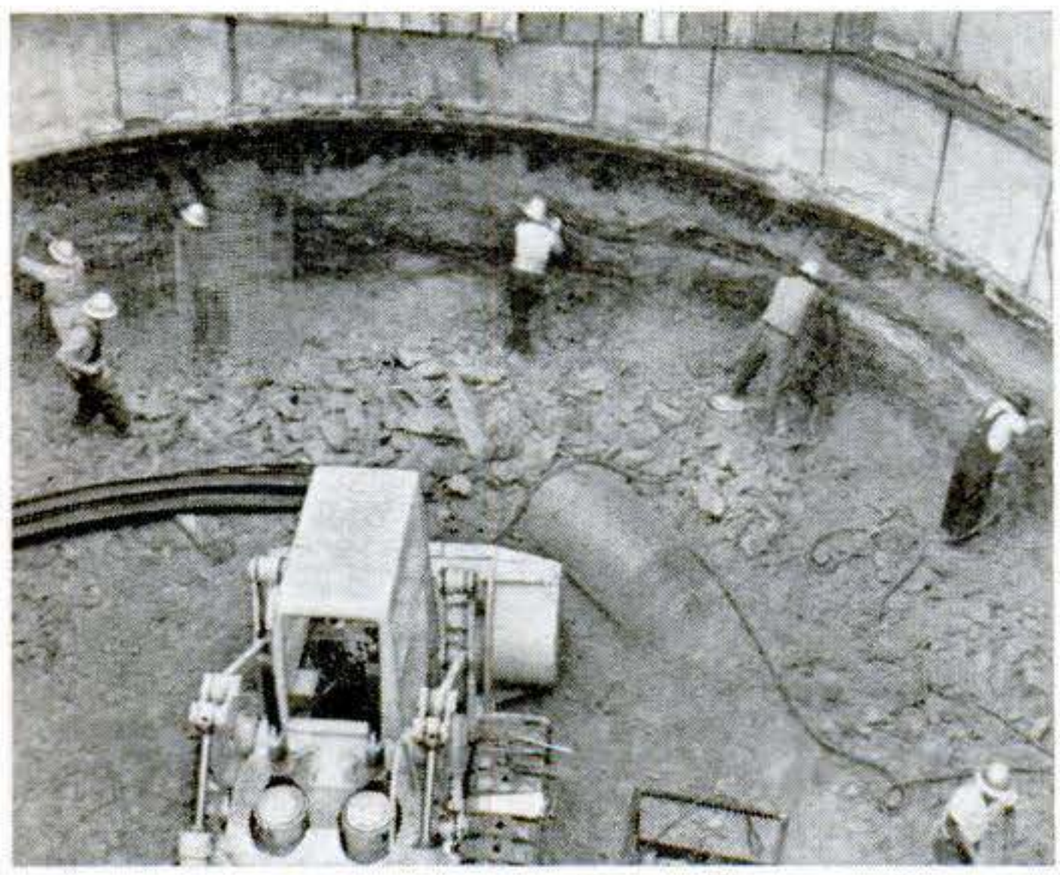
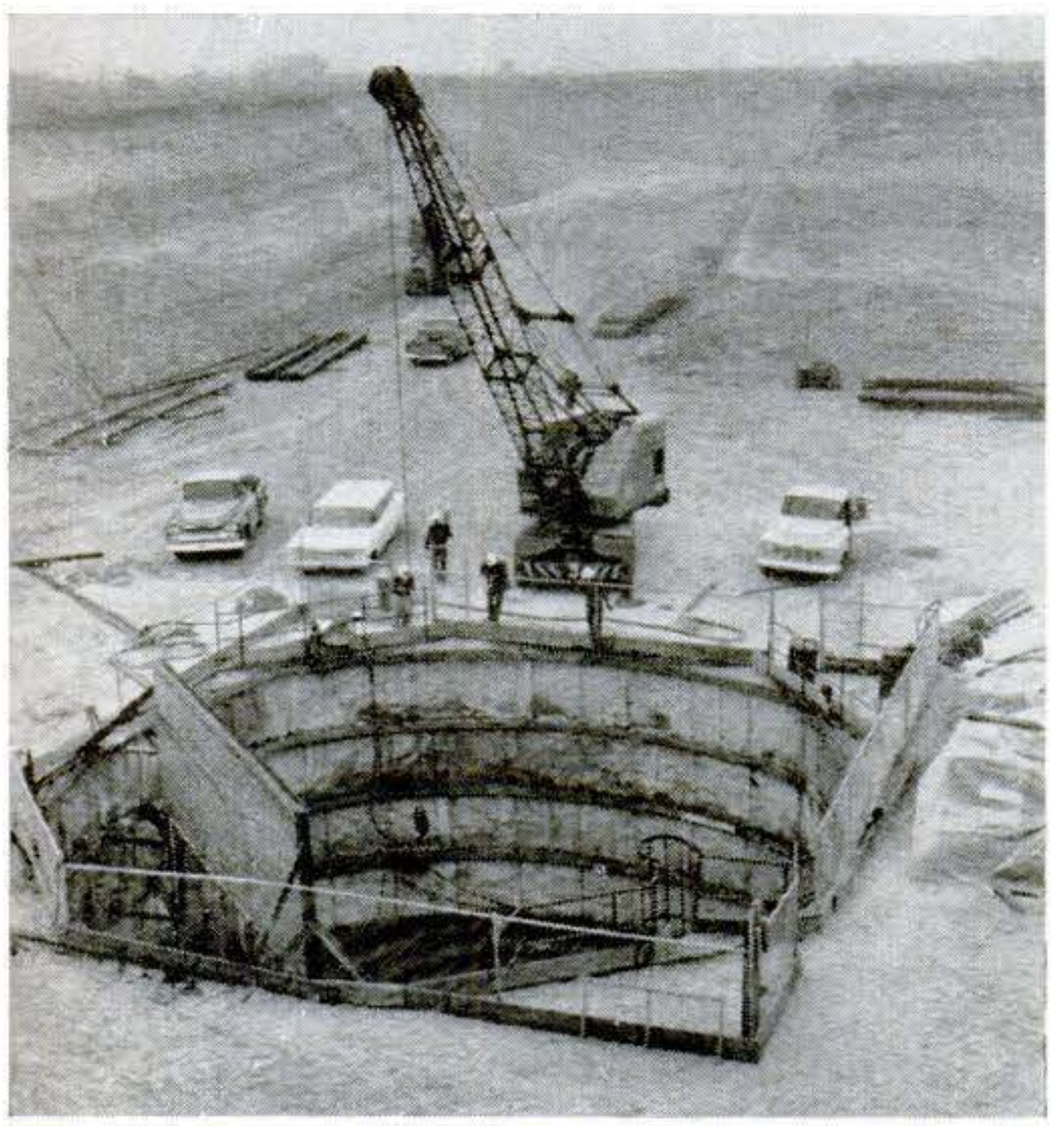
SQUADRON OF BULLDOZERS first scrapes off 40 feet of soil where a missile site is to lie. Then the entire site is constructed at or from that level, and buried when finished.



INSTALLING WIRE MESH along the rough earth wall of a silo hole 40 feet wide, workmen prepare to spray on a retaining coat of concrete. The poured lining will be two feet thick.



IT'S 120 FEET TO THE BOTTOM of this missile-silo hole. But the top must be level with the plain. So a collar of reinforced concrete, 40 feet high and eight feet thick, will be added.

eters while cranes lifted out the loosened earth and trucks carted it off to be piled handily for future backfilling. Constructing the six launching sites at Lowry will involve excavating 3,200,000 cubic yards of dirt in cuts and shafts.

Each site contains three missile silos, with attendant terminals for mixing fuel and oxidizer. There'll be storage tanks for these essential fuels, and storehouses for equipment and spare parts. A single control center and a powerhouse of the same size and shape serve each trio of missile launchers. These buildings are circular and domed for greatest structural strength. Their domes will be two feet thick, and 17 feet of earth will eventually cover them.

Connecting tunnels, 9½ feet wide and lying from 38 to 55 feet below the plain, will carry communication and control lines, and enable the crews to move about. Two sets of double blast doors will be installed in the tunnels, like safety hatches in a submarine, for crew protection. Each site will have its own supply of water, filtered air, and oil.

There will be an elevator shaft to bring men, equipment, and supplies into each buried site. Two other shafts will contain directional antennas, also on elevators, to guide the missiles at the start of flight.

Vertical assembly line. The biggest elevators will occupy the missile shafts. The 90-foot, 110-ton Titans will be assembled on them and lowered as assembly progresses. So-called cribs within the silos will support elevators and missiles and provide galleries for crewmen. The missiles are to have special shock suspension. In case of attack, the Titans will be fueled and launched by remote control. As the silo doors swing open, each missile will rise with a flame deflector attached to its base. The curved shield, for protecting the shaft, will drop off as the missile is launched.

The six-site Lowry missile base will consume 200,000 cubic yards of concrete and 70,000 tons of steel. It will cost nearly $70,000,000 to build, and an estimated $50,000,000 more to equip.

Winter's stern weather on the Colorado plains is not interfering with construction. It's fairly cozy down where the workmen are. But they are having to use hot water for mixing concrete.—*Wesley S. Griswold.*

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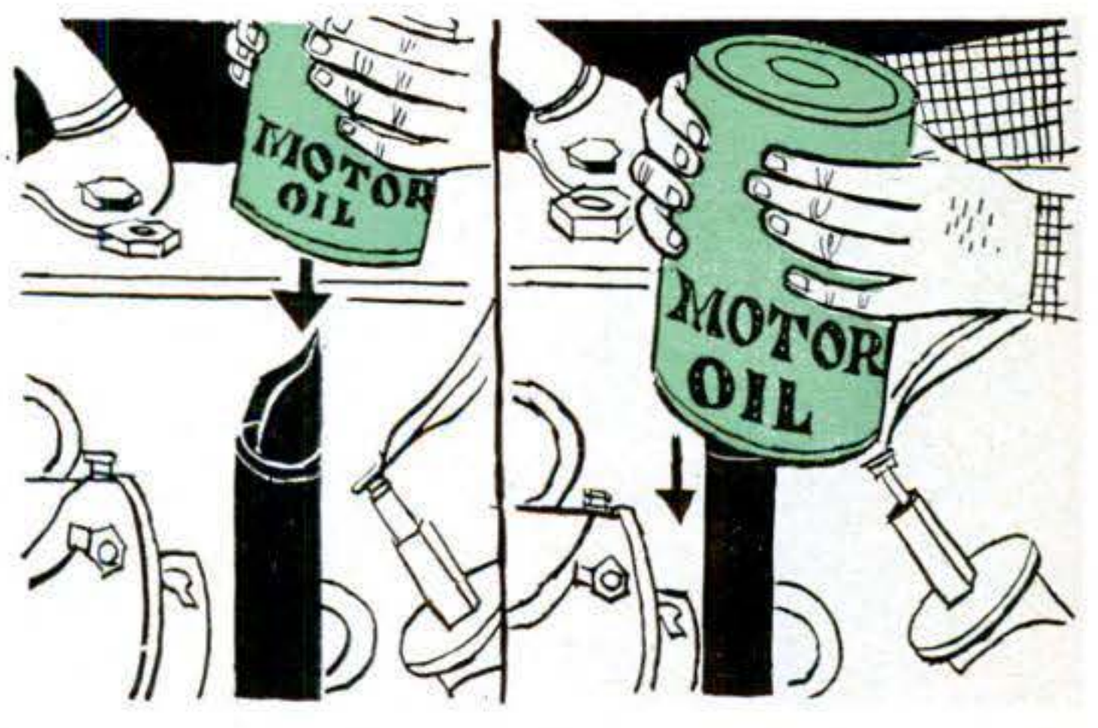
"I'd like to see them make..."

A CHIN STRAP ON MEN'S HATS. Tucked behind the sweat band, it could be lifted out on windy days and snap-fastened to the face of the band. —*Jim Martin, St. John's, Newfoundland.*

INDIVIDUAL PASTE POTS for schoolroom use. They'd hold just enough paste for one child's project, eliminate sticky jars and dried-out paste. —*Nathan Bridwell, Midland, Mich.*

RUGS WITH POCKETS at the four corners into which the rug pad could be inserted. Pads are always shifting and showing at the edges and this would anchor them.—*Joan Bost, Chicago.*

INSULATING GUARDS for soldering guns. With only the tip of the gun exposed, you wouldn't burn other parts when soldering in a radio chassis.—*H. G. Radcliffe, Petersburg, Va.*



CAR OIL-FILLER SPOUTS that would pierce metal. Then you could shove the can onto the spout, after removing the breather cap, and pour in the oil.—*H. T. Gibbons, Scottsdale, Ariz.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

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A procession of men and machines laying new steel stretches for a quarter-mile up the track.

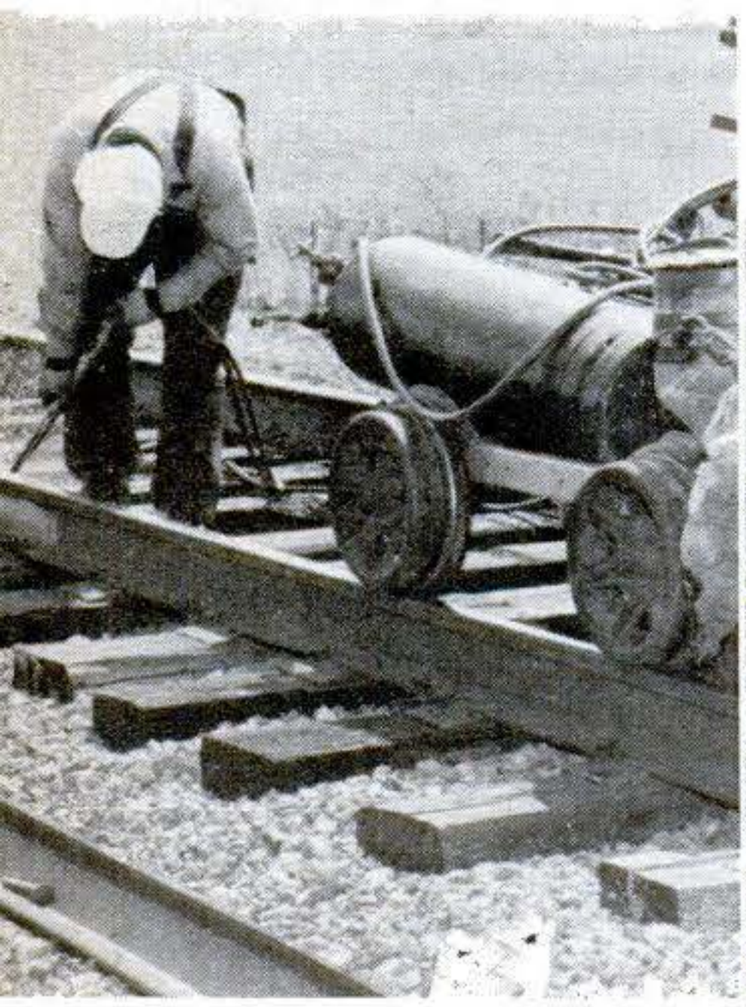
Today's gandy dancers use machinery instead of muscle for the railroads' biggest maintenance job

Rolling Assembly Line Lays Steel Faster

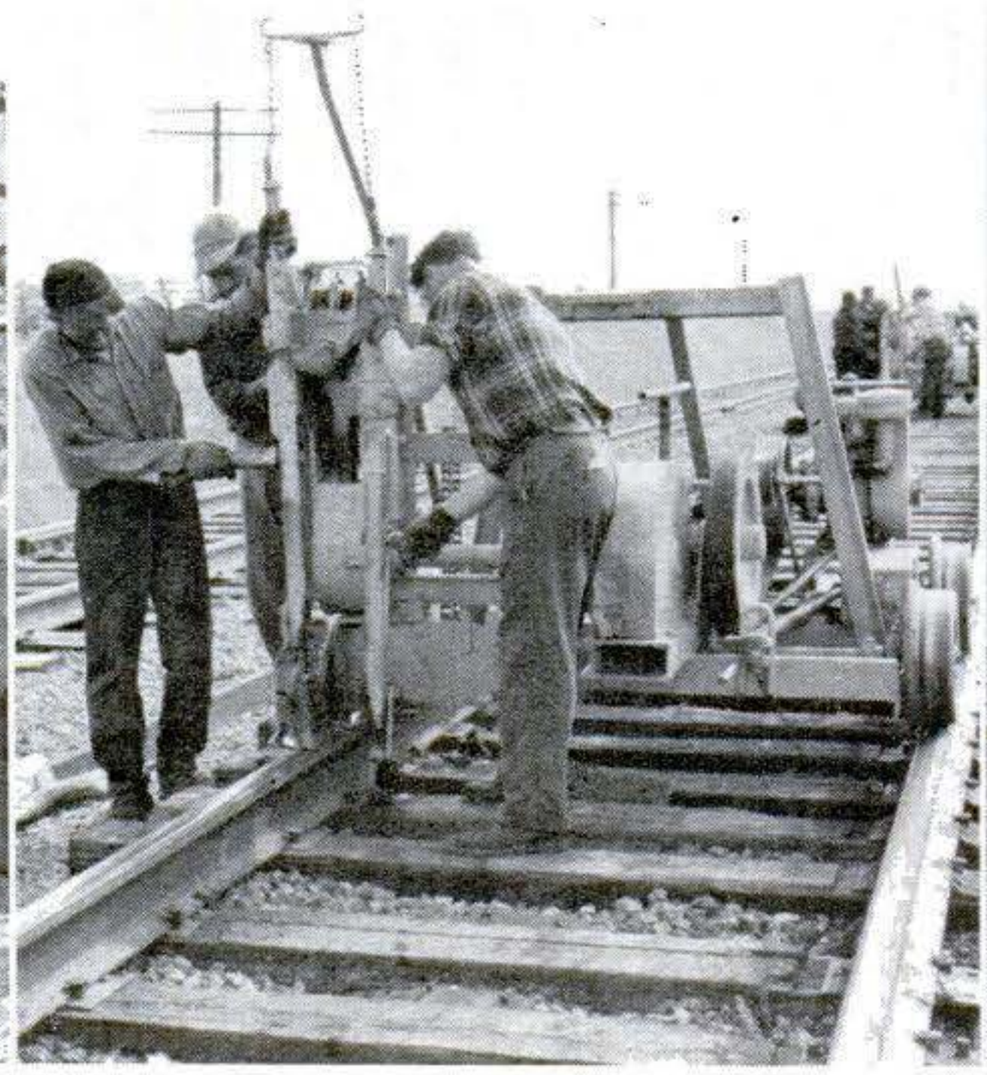
WORKING on the railroad no longer involves the rough physical labor it used to, back when steam locomotives were in their heyday.

Gandy dancers—railroad jargon for the men of the steel gang—still lay new rails. But the 200-man gangs that horsed around 1,500-pound steel rails, mostly by hand, are gone. Gone, too, is the pick-and-shovel method of chucking a bed of

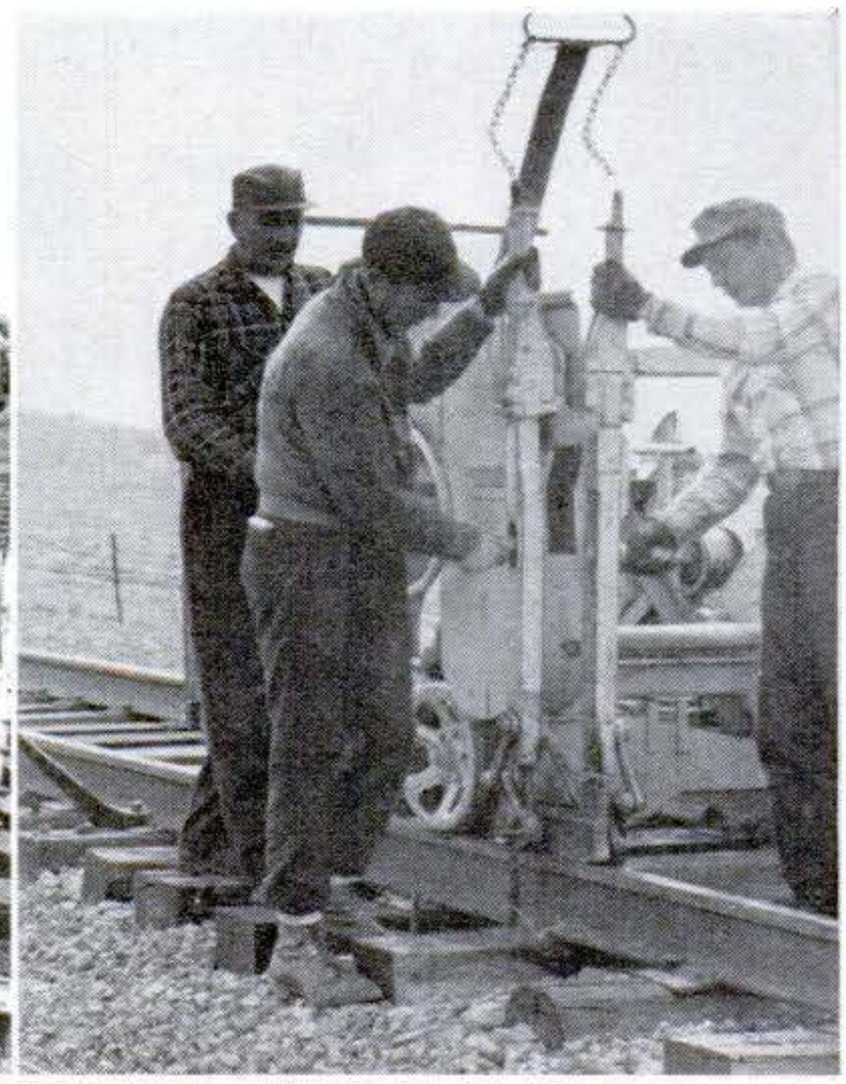
1. Up comes the old steel



OXYACETYLENE TORCH makes quick work of rusted bolts that fasten joint bars to worn rails.



LIKE A JUMBO CLAW HAMMER, gasoline-driven spike puller straddles the rail. Tongs are lowered over the head of one spike on either side of the rail and . . .



"WHANG!" With a sound like a giant champagne cork, spikes pop out. Men behind now lever rails off.

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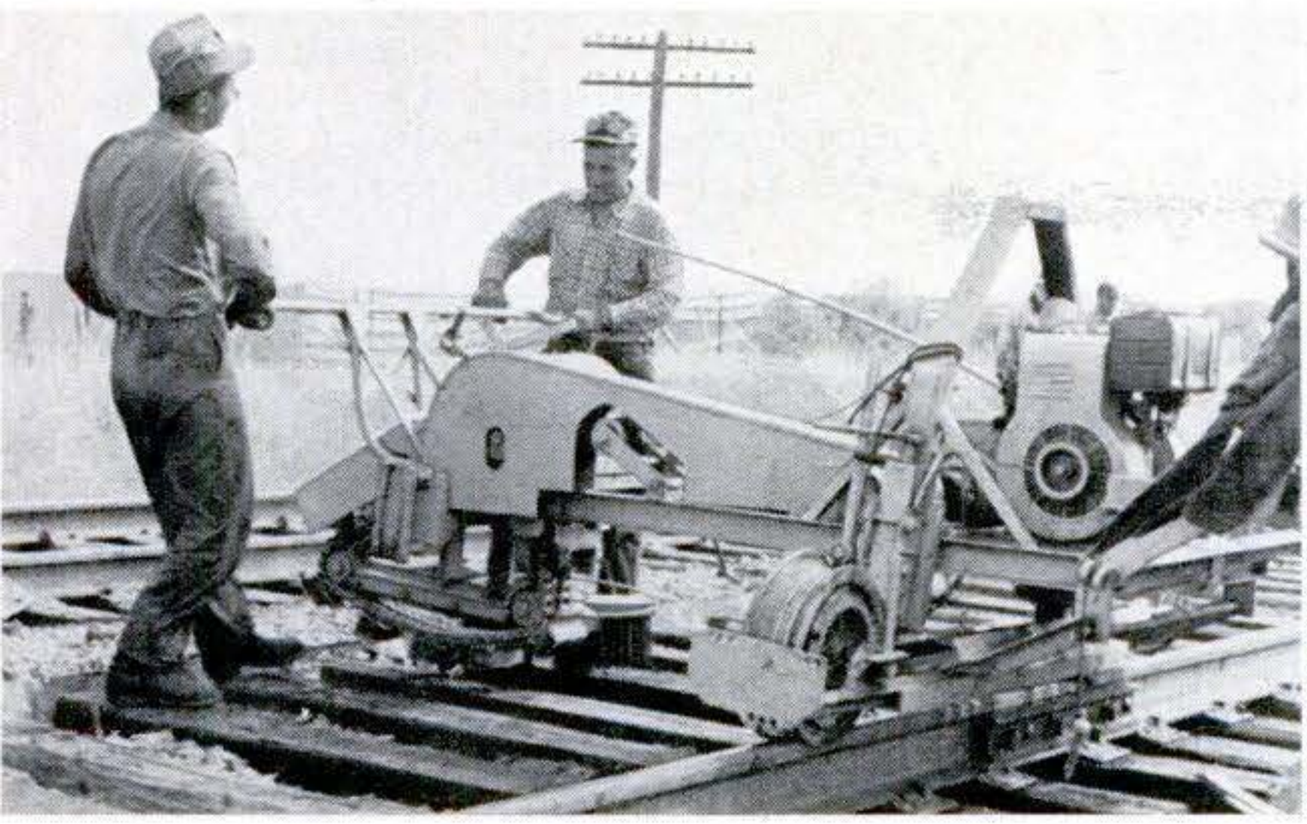
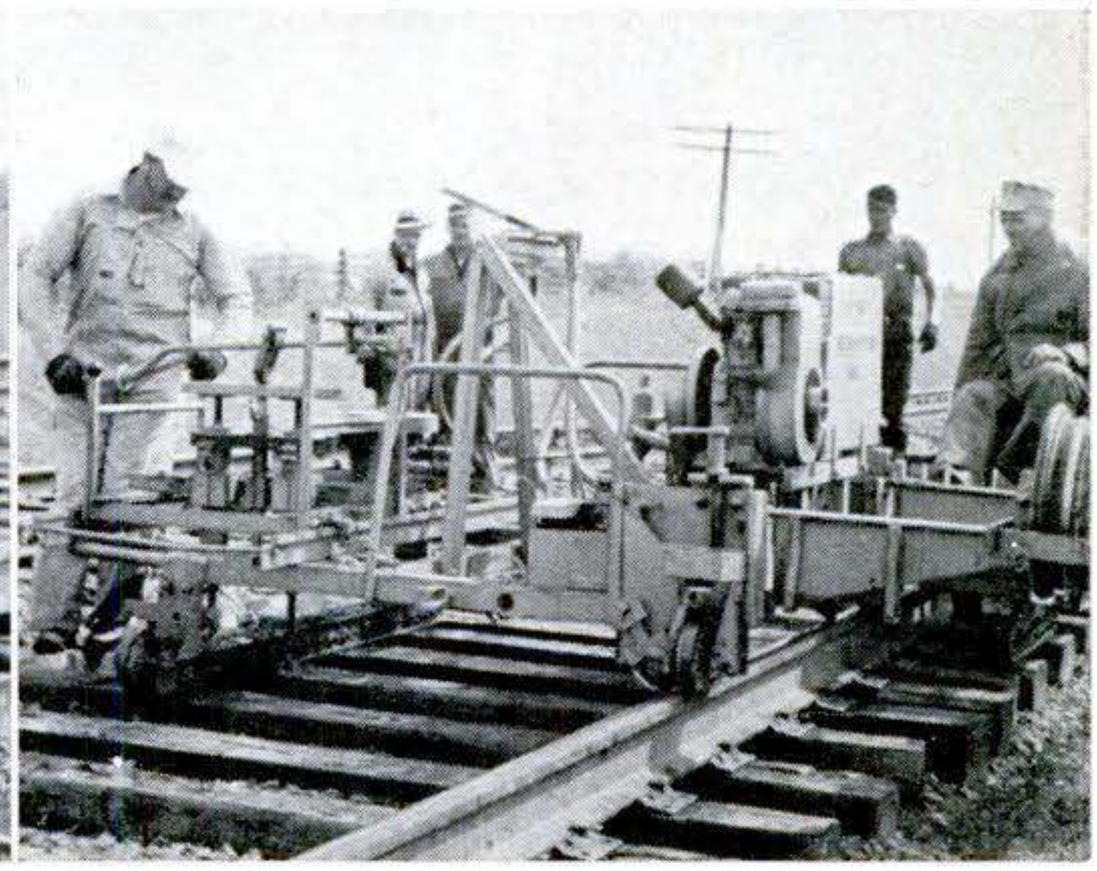
2. Old ties get a new lease on life



TIES ARE CLEANED UP by a combination scoop and brush. Scoops, on an endless chain, claw ballast away from the end of the tie. A whirling brush sweeps away the mess made by scoops.

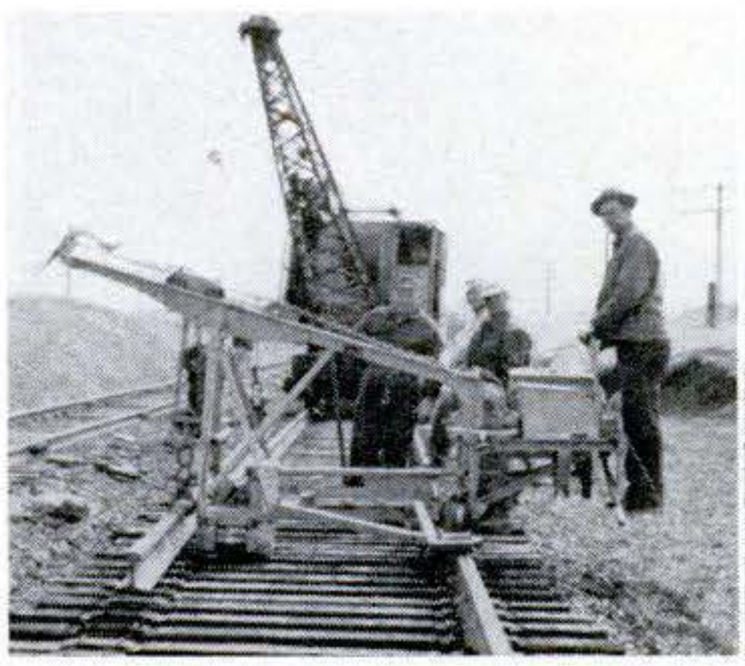
ROTARY PLANER SMOOTHS the old tie after a workman has driven wooden plugs into the holes left by pulled spikes. Tie surface must be flat so new plate and rail will bed firmly.

NOT MISSING A TRICK, the next two-wheeler is a gadget that sprays preservative oil on the wood newly exposed by the planer. Oil drum, cradled on the sprayer, is easily replaced.

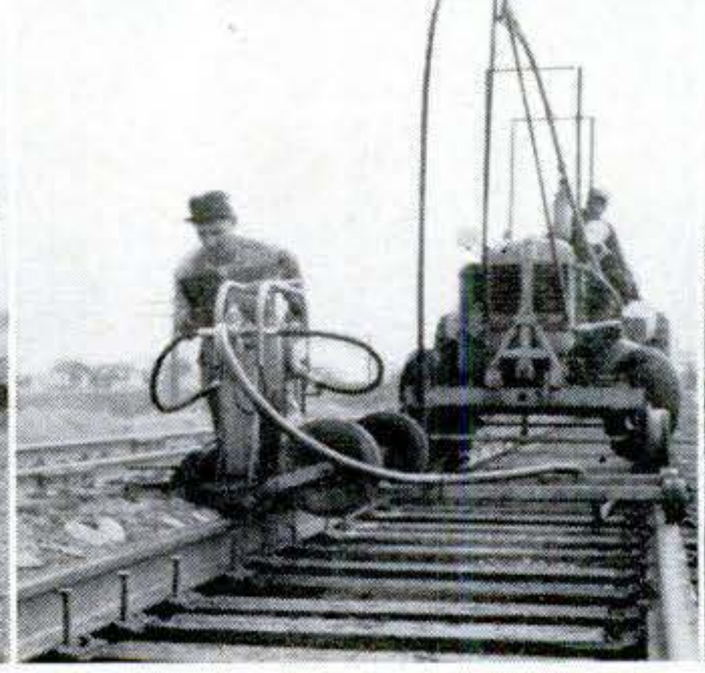


BY DRILLING TWO GUIDE HOLES in every fifth tie, machine sets the track gauge (distance between rails). Rail plates pinned at the holes serve as guides for lining up the new steel more easily.

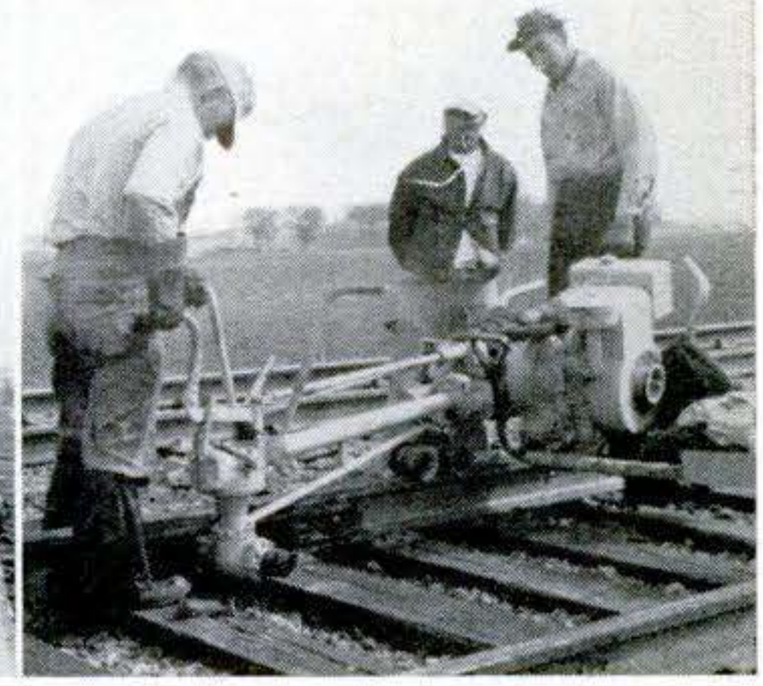
3. Other machines lay down the new steel precisely



BIG CRANE and little hoist team up to position a new rail. Chain hoist lifts the near end, travels on a wheel and a track.



WHAMMING SPIKES HOME, pneumatic spike driver replaces sledge hammer. Air compressor is on tractor.



POWERED SOCKET WRENCH runs up the track nuts that fasten joint bars. The double-ended wrench swings to either side.

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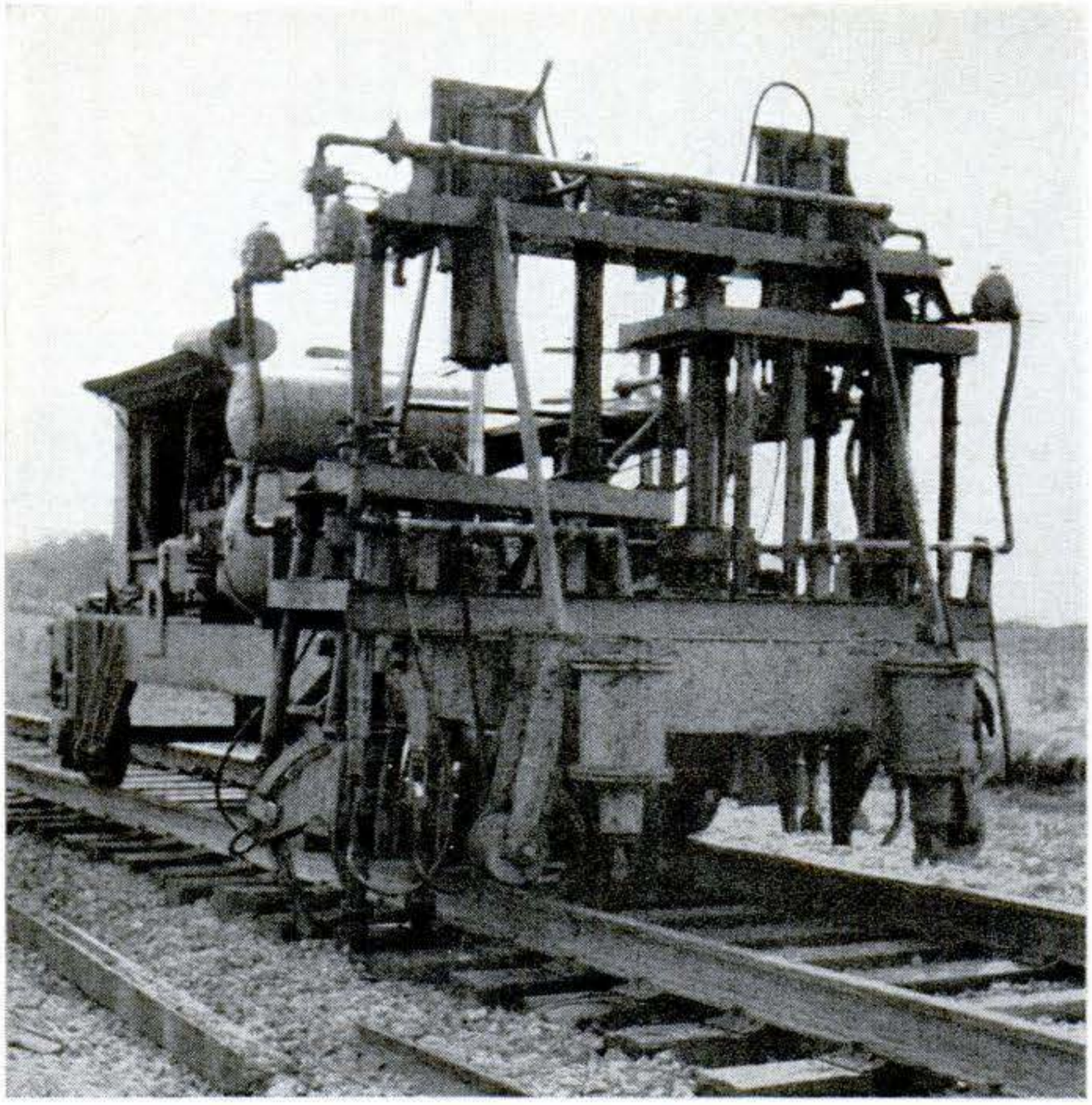
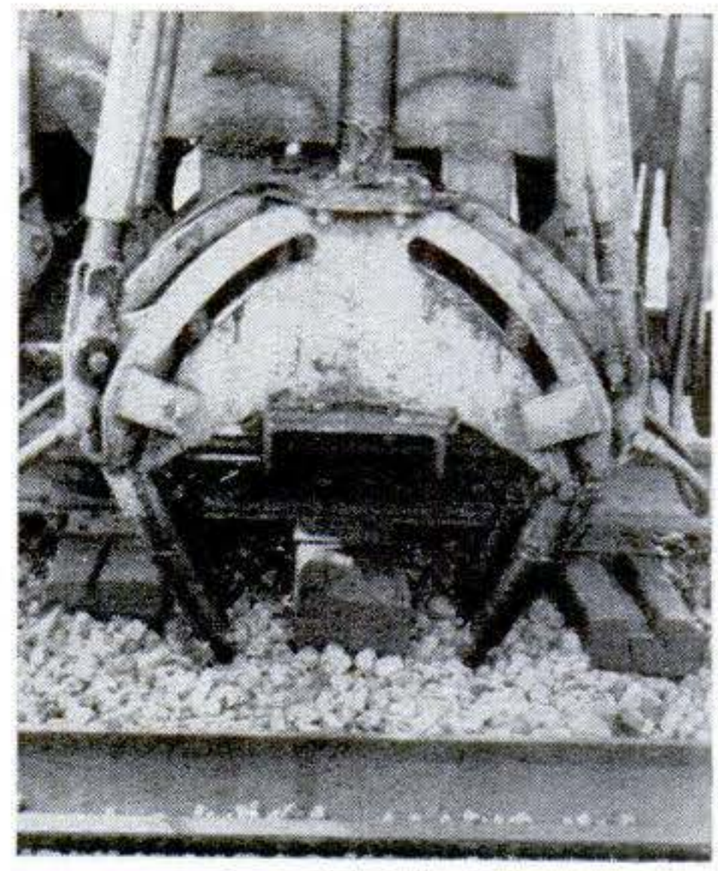
4. Pick and shovel work is mechanized, too



MAKING A FIRM BED for the new track to lie on is this monster's job. It chucks fresh ballast rock around the ties, strewing it faster than pick-and-shovel men.

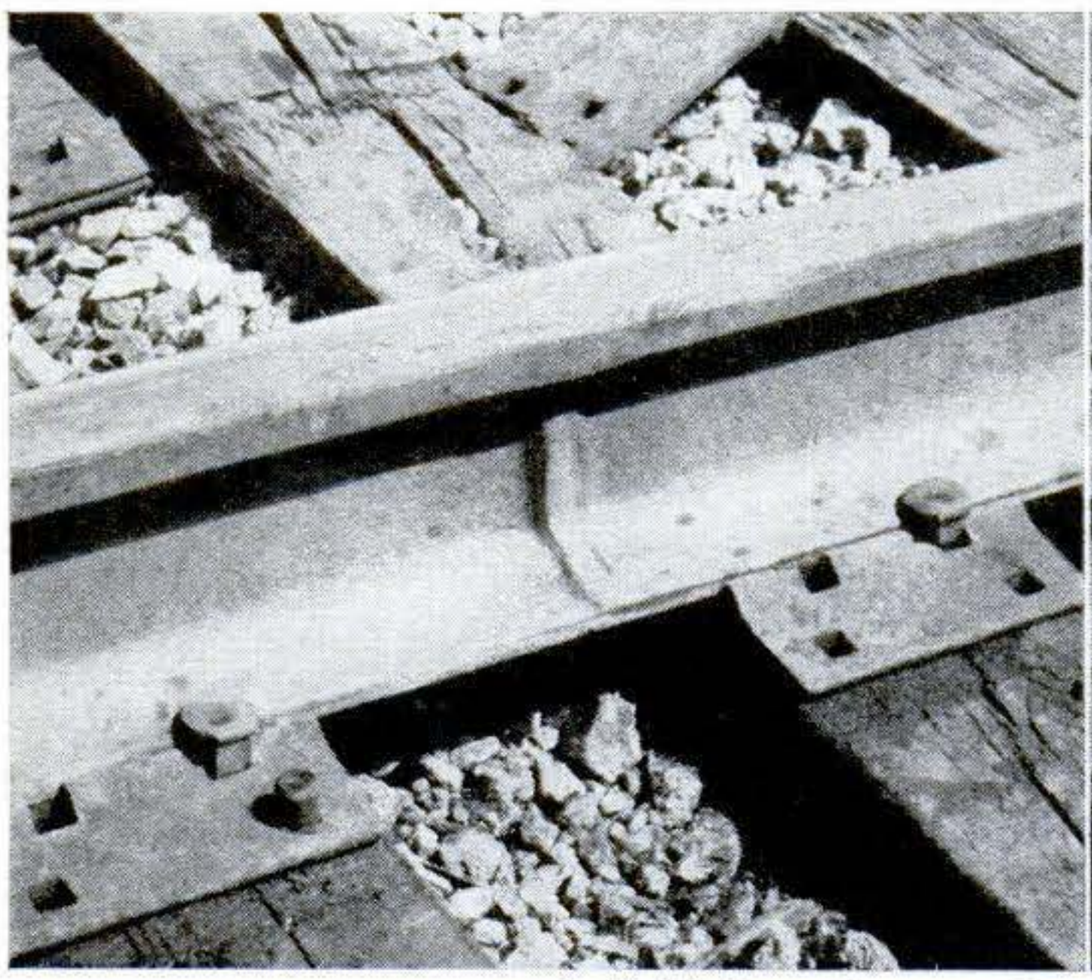


CLOSE-UP shows air-operated forks jabbing ballast around a tie. Old rail in the foreground still has work ahead. It will be relaid on a branch line.

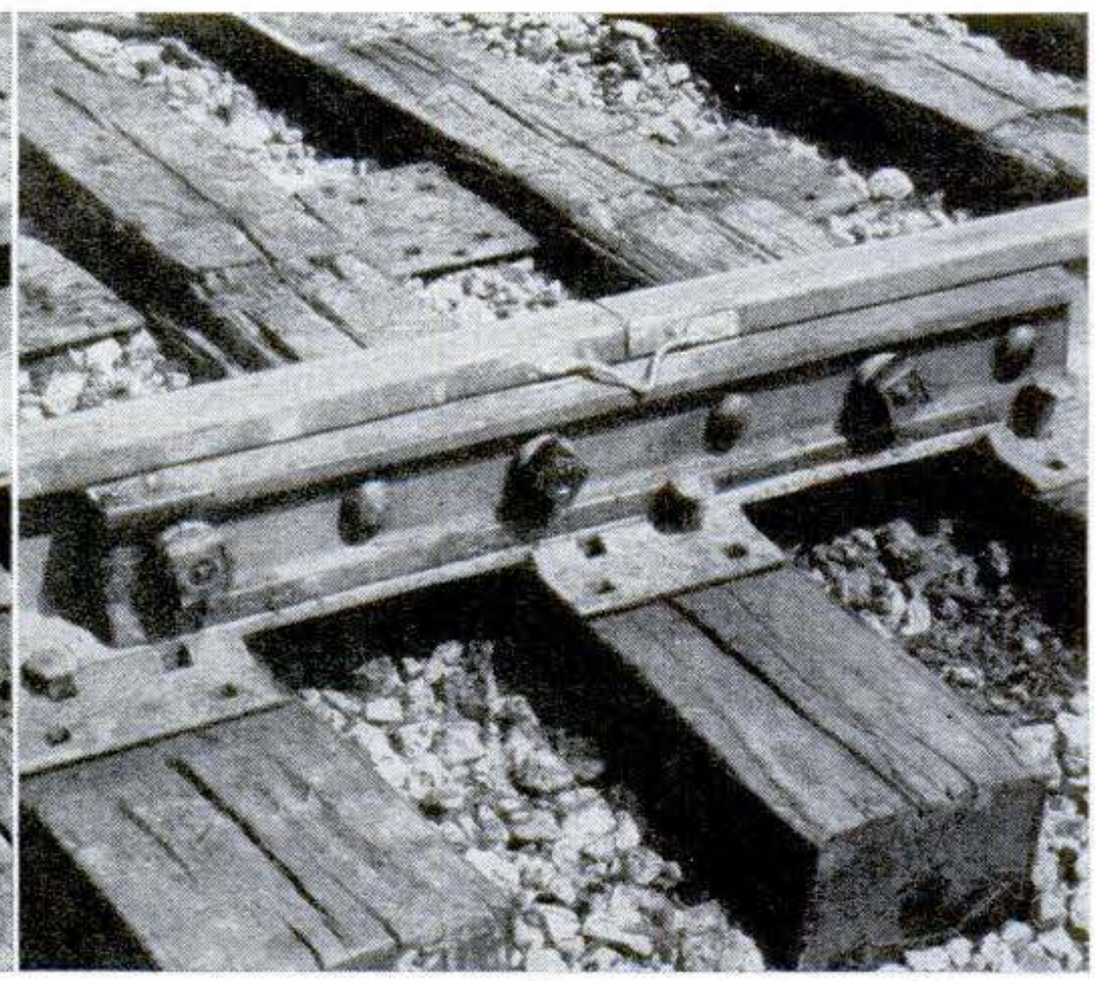
rock ballast evenly around the new ties.

Today's gandy dancers work in teams of fewer than 100 men. They use strange-looking machines, on a mobile assembly line that follows the rails. It moves a mile and a half a day—pulling up the old, worn rails and preparing the roadbed for new ones. When the procession has passed, the new tracks are seated, gauged, and ready for business.

Depending on traffic, rails must be replaced every three to 10 years. One set of ties outlasts three sets of rails. These photos were taken on the main line of the Chicago Northwestern Railroad, in eastern Iowa.—*Phil McCafferty*.



CLICKETY-CLACKS are cut in half these days with double-length rails. As the 39-foot sections come from the steel mill, they are pressure-welded together in the railroad's shops to form shiny ribbons stretching 78 feet in length.



A FINAL TOUCH in rail-laying is the welding on of wire straps to connect the rail ends. Rails must be electrically continuous because they are used as an integral part of the signal-system and train-control circuits.

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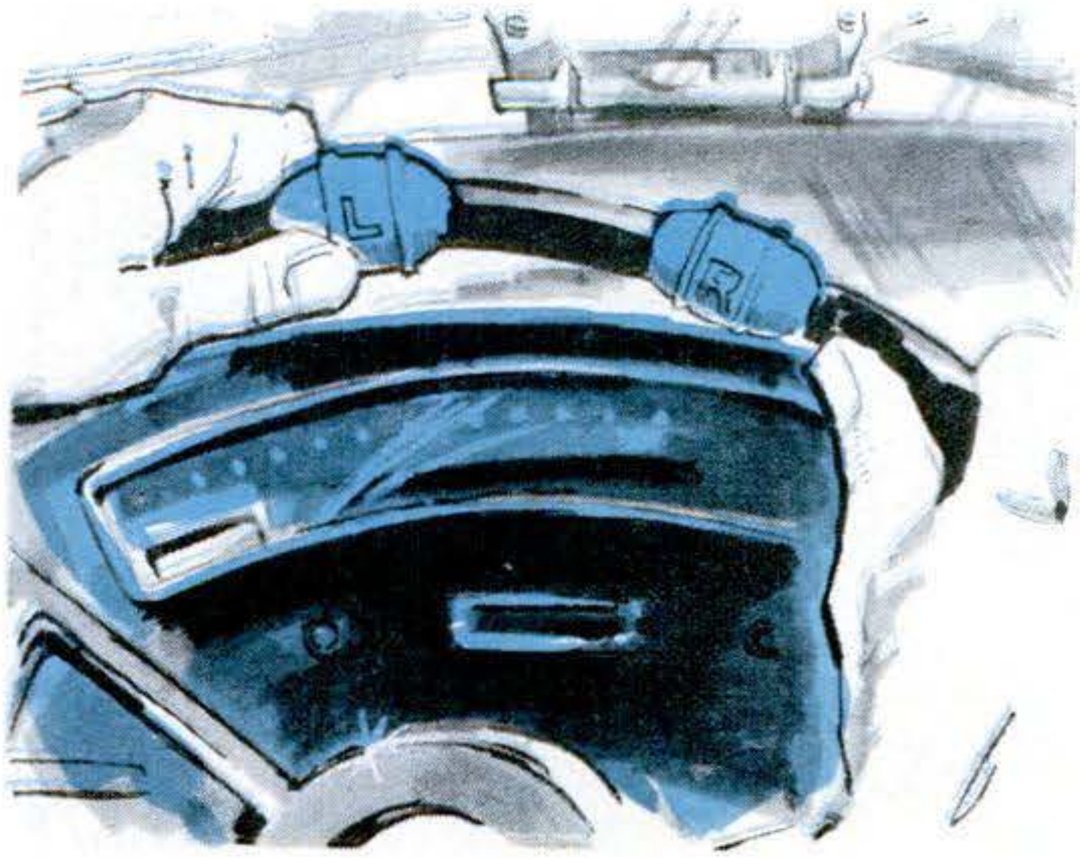
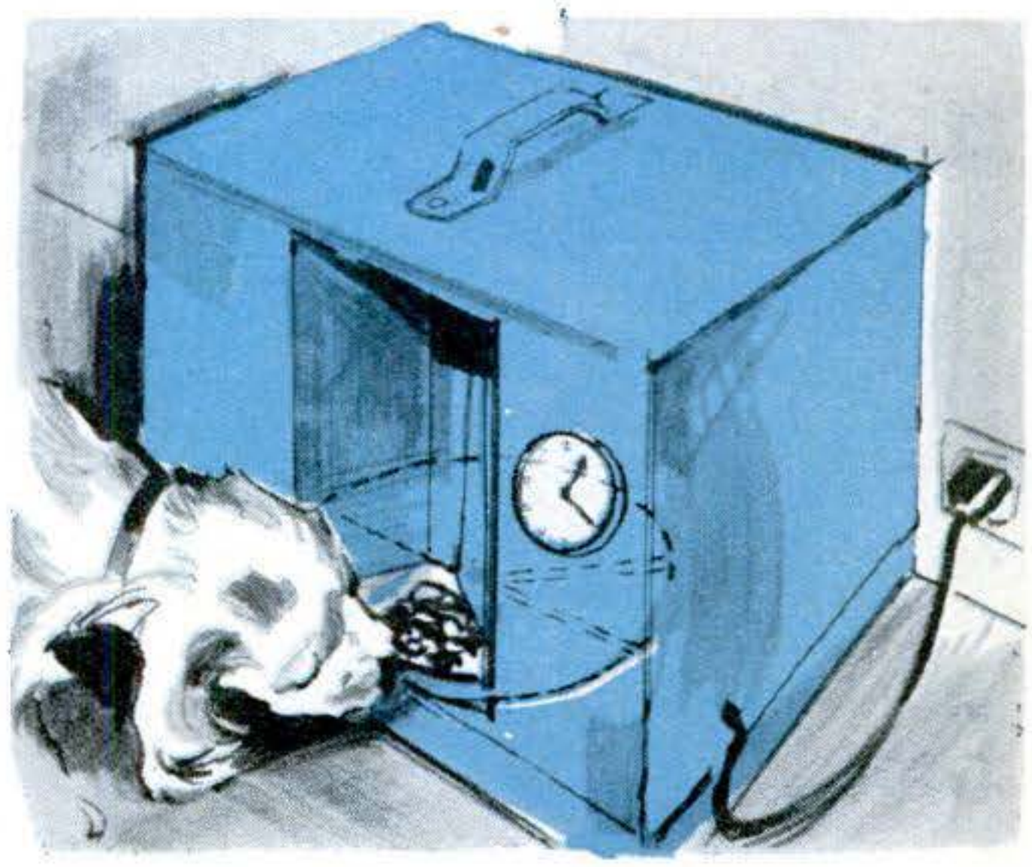
New Ideas from the Inventors

Tiller Adjusts Outboard Draft. By extending the support behind rather than below the transom, this recently patented motor mount would make it easier to beach or launch a boat, or steer it through weeds or shoals. Doubling as a lever, the tiller would raise or lower the motor by moving spring-balanced parallel arms.

Thumb Switches Signal Turns. You could flash your turn blinkers while keeping both hands on the wheel if you had rim switches like these convenient to both thumbs. A push or twist of either switch would close its circuit; springs would open it as pressure was removed.



Timer Feeds Pets on Time. With this automatic dispenser on the job, you could get away from your pet for a while without worrying about his food. You'd set out his meals in the sections of a Lazy Susan, and a clock would advance each one, on schedule, to an opening in the cabinet.



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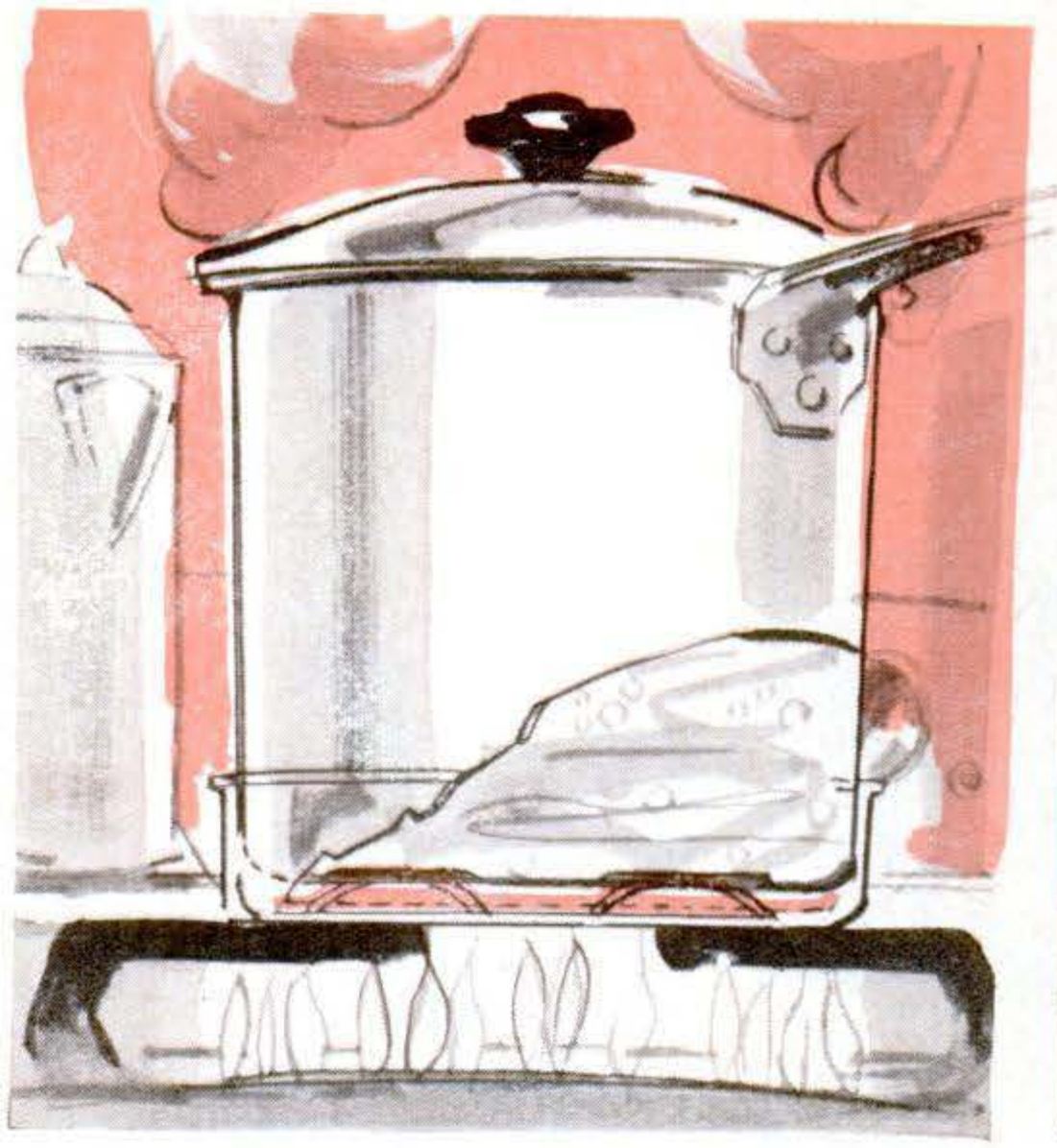
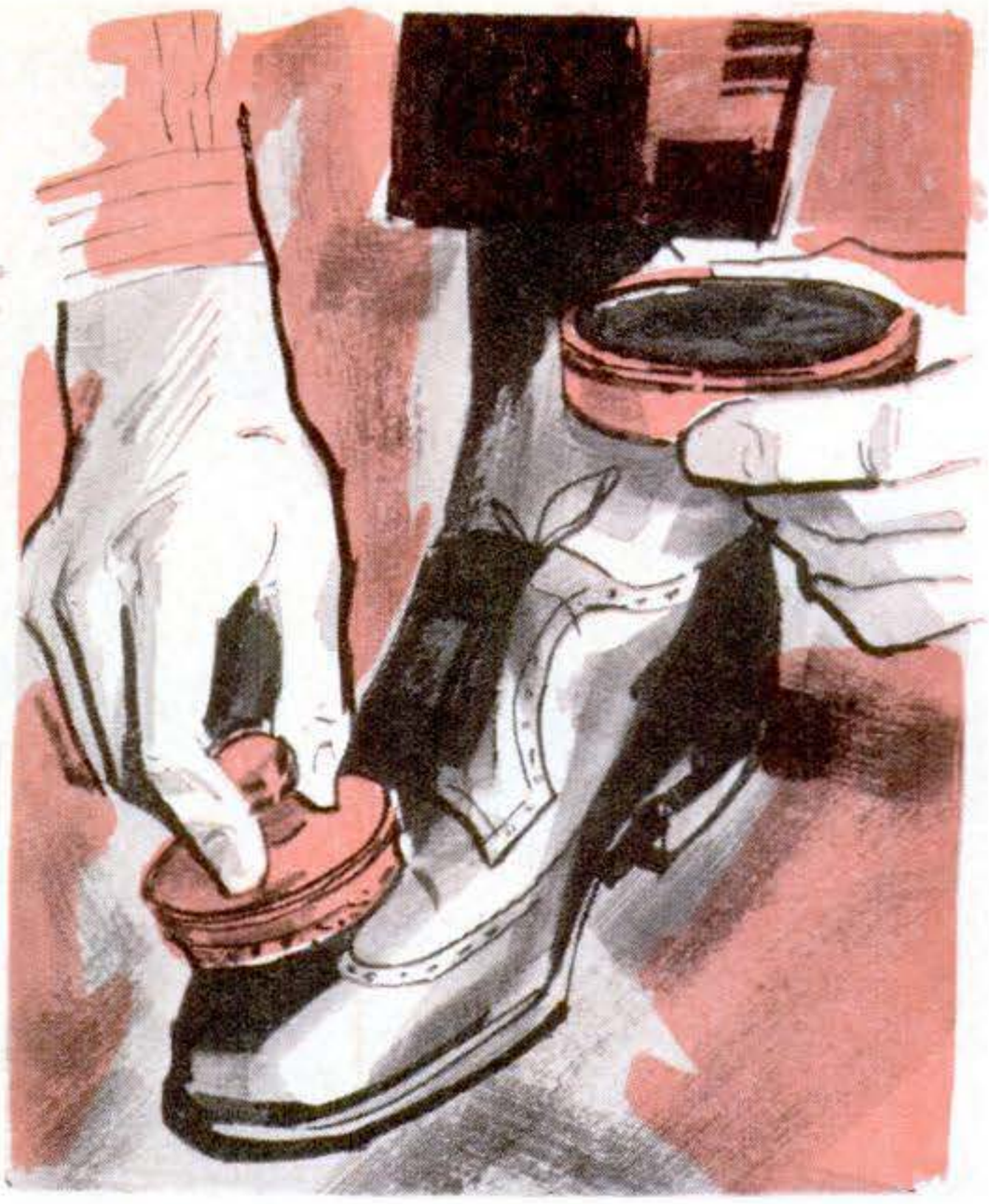
More Inventors' Ideas

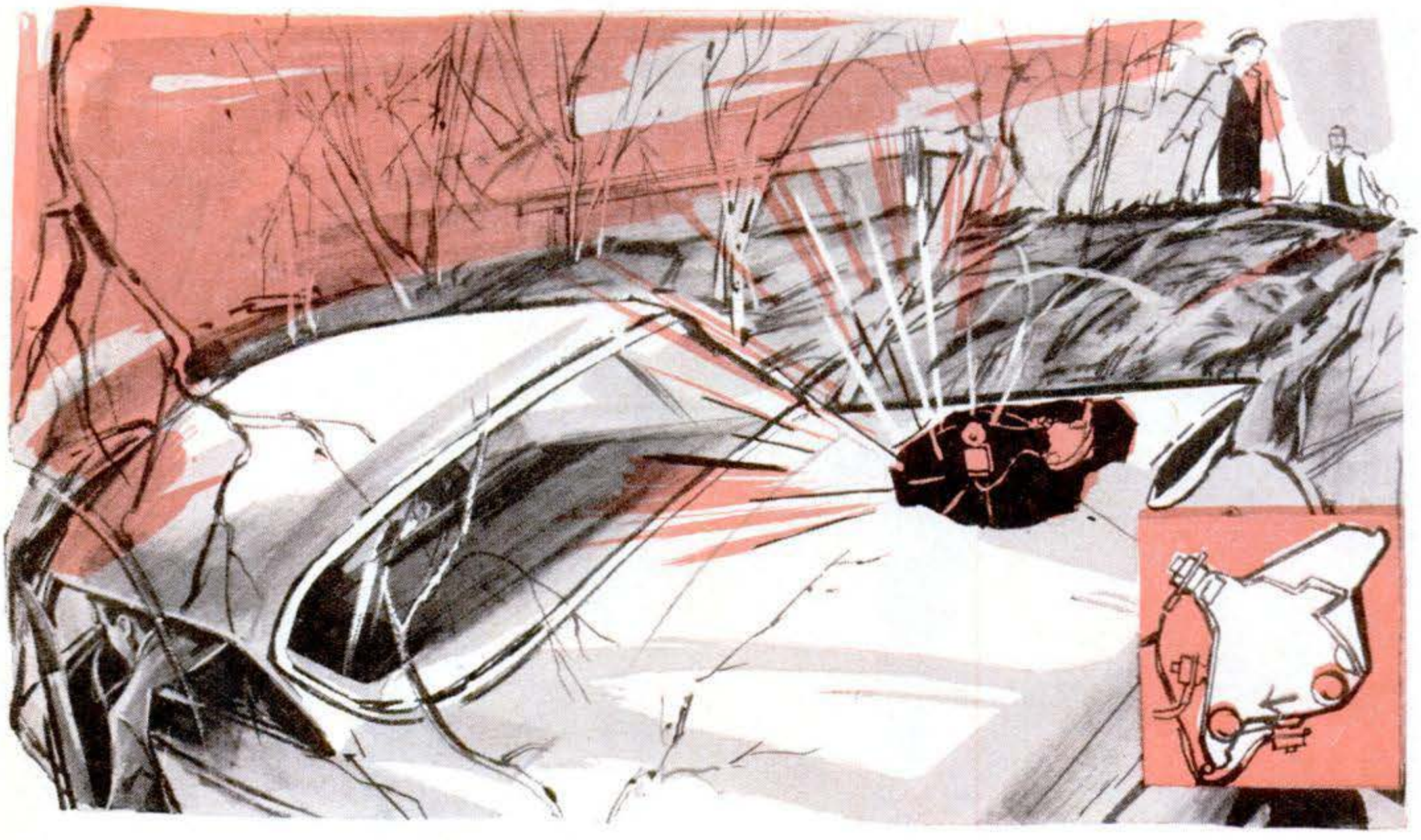


Pan Regulates Its Own Heat. Bimetal strips would control the heat of this double-bottom pot by raising or lowering the upper section above the flame. A flanged sealing ring that limited the sliding fit would conserve heat and keep the sections from separating completely.



Cover Pad Applies Polish. You'd be able to clean your shoes without soiling your hands if your polish came in a package like this. A knob on the top of the lid and a rotating applicator sponge on the bottom would let you scoop and spread the polish without touching it.

Accident Bell Summons Help. If a car that had this tilt alarm were to tip or roll over, one or more metal balls inside a curved shell would roll down and bridge the contacts of a horn or bell circuit. The automatic signal is designed to speed assistance to trapped or disabled victims of lonely-road or off-road accidents.



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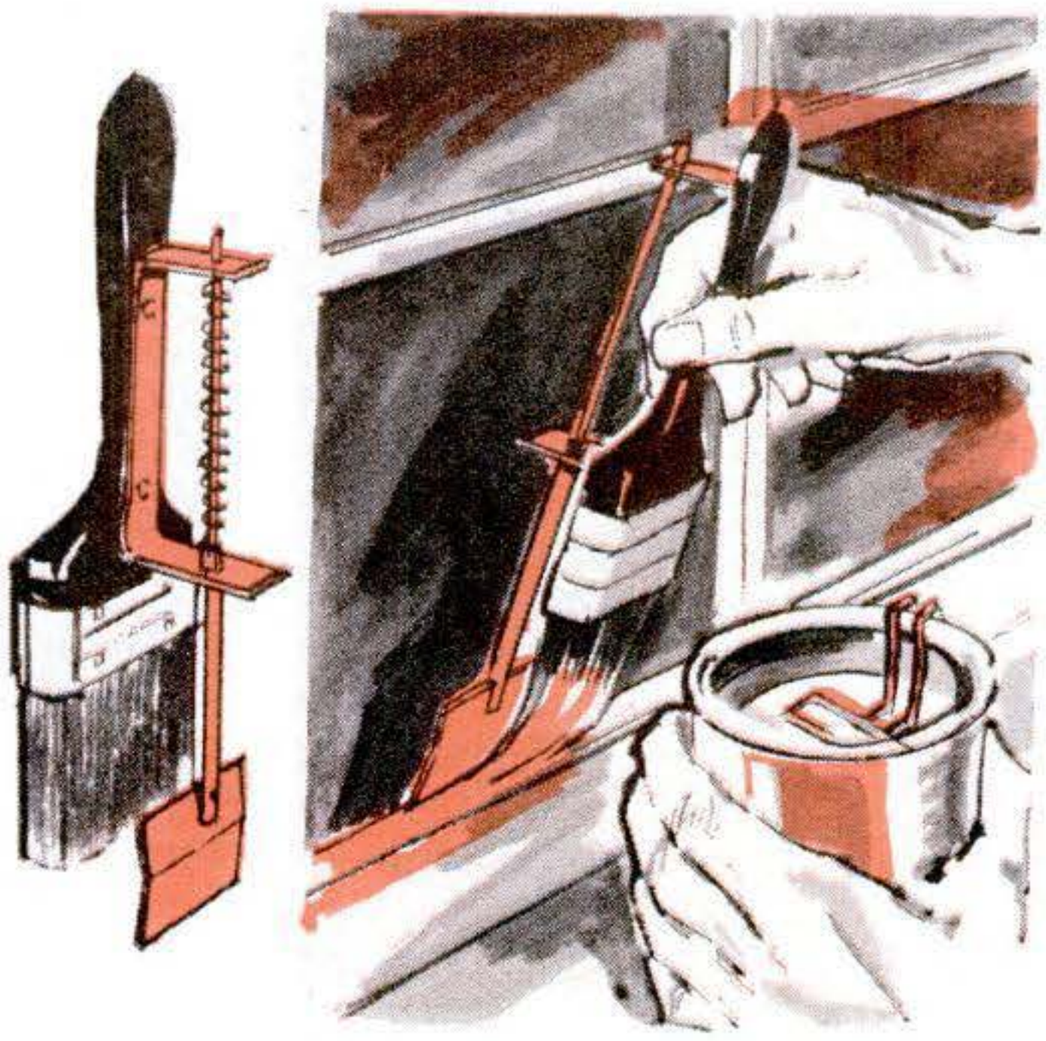
Phone Base Lowers TV Sound. You wouldn't have to adjust radio or TV volume when you answered the phone if your set were wired to this phone base. Lifting the handset would close a weight-sensitive switch, cut in a volume-lowering resistance across the speaker coil.

Trim Guard Guides Brush. This combination guide and mask might help you apply paint trim faster, and keep margins sharper and cleaner. Bracketed to move upward against a spring, or to tilt inward toward the bristles, the guide plate would fit and follow corners. A companion clip on the rim of a paint can would lift the guide when you dipped the brush.



Glove Lights Traffic Signals. You wouldn't confuse a policeman's stop-and-go signals if he wore this traffic glove. Reflective dyes—colored red in front and green in back—would make his gestures clearer. And by reflecting headlight beams, the glove could be seen farther.

The following patents have been issued on these inventions: **Outboard mount**—*No. 2,782,744 to T. Staley, Eagle Point, Ore.;* **Turn signals**—*No. 2,793,262 to O. Albert, Gonzales, Tex.;* **Feeder**—*No. 2,791,984 to R. Franklin, Elkhart, Ind.;* **Pan**—*No. 2,782,782 to A. Taylor, East Haven, Conn.;* **Polisher**—*No. 2,789,301 to S. Harvey, Brooklyn;* **Bell**—*No. 2,794,084 to A. Segoni, Florence, Italy;* **Phone base**—*No. 2,792,450 to Z. Hof, Rochester, N.Y.;* **Brush guide**—*No. 2,791,790 to N. Cooley, Kansas City, Mo.;* **Glove**—*No. 2,787,236 to E. Welch, East Otis, Mass.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

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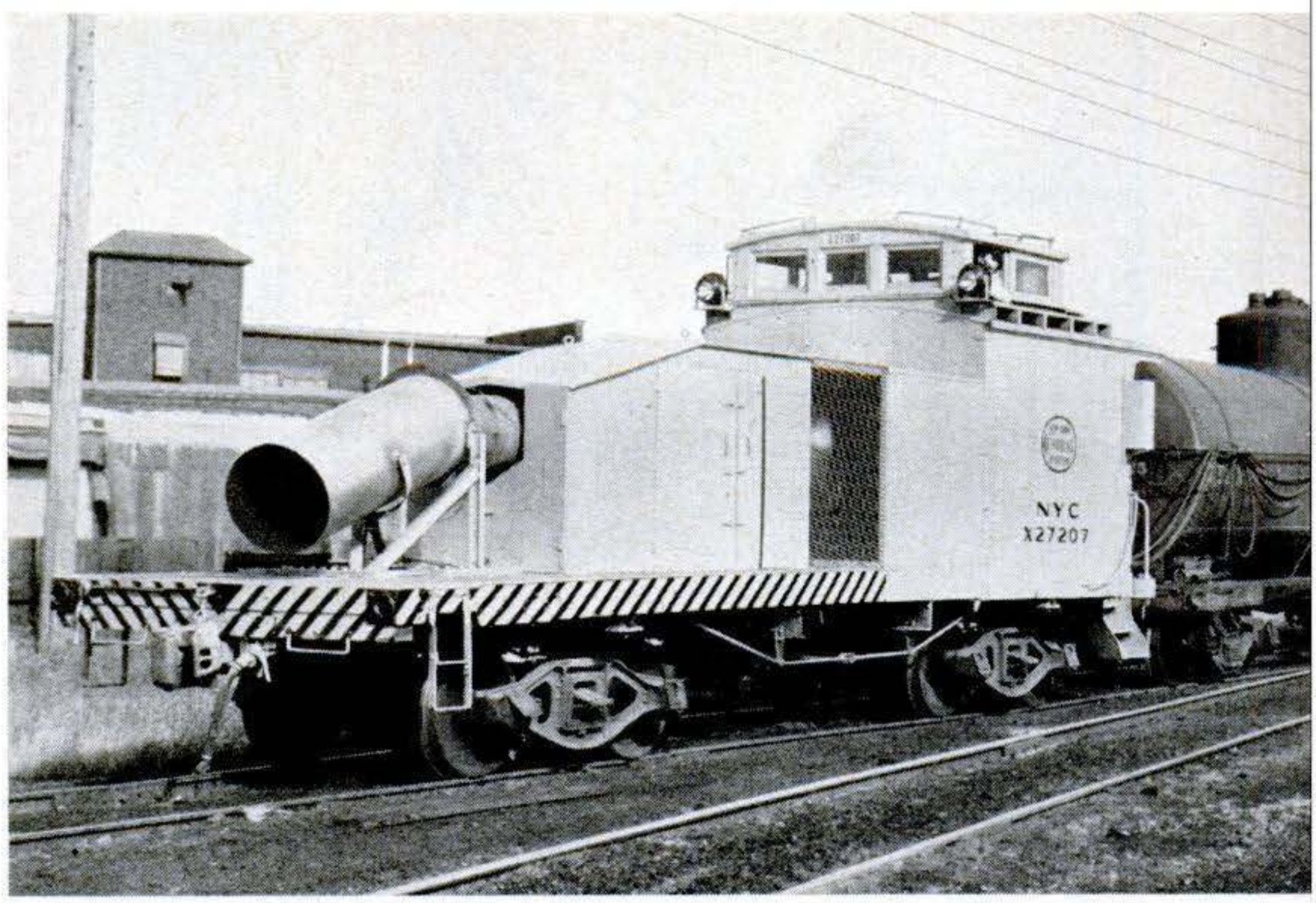
B-36 jet blasts snow off tracks

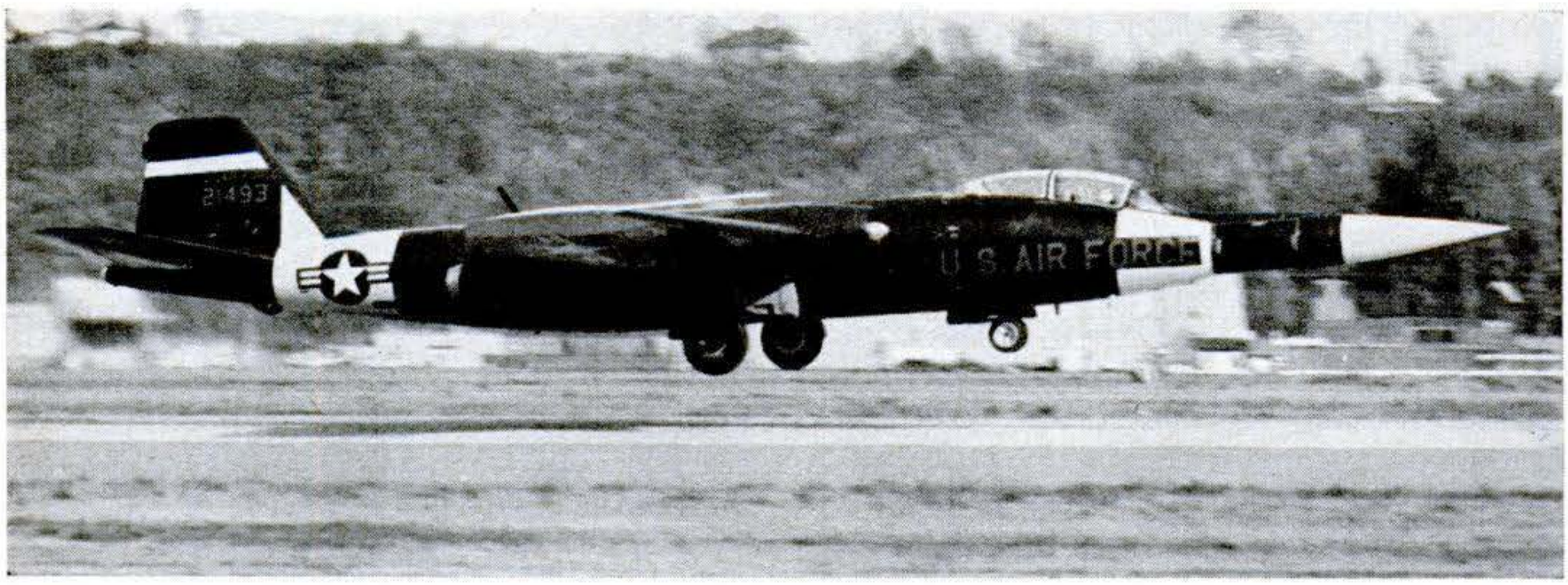
The New York Central Railroad put a new snow plow to work last winter. It's a B-36 jet engine.

The railroad bought a surplus jet, mounted it on a caboose, fed it diesel fuel from a tank car coupled behind.

With exhaust roaring at 1,000 m.p.h., railroad crews blow tracks and switches free of ice and snow. Cooling air is added at the nozzle so the blast blows the snow without melting it.



Operator in the cupola controls direction of the 5,000-hp. jet . . .



Missile-nosed bomber

This B-57 Canberra jet has the nose cone and part of the guidance system of a Bomarc air-defense missile grafted to its fuselage. It was used to simulate the missile in checking to see if Eglin Air Force Base's Gulf Coast test range could handle 400-mile Bomarc flights. The plane replaces the missile's ramjets.

Curbside library

Like a drive-up mailbox, the device at left also takes deposits. It was put up for the convenience of patrons of the Harrison Memorial Library at Carmel, Cal., who drive there to return borrowed books but can't find a parking space.

The receptacle is operated like a slot machine. When the lever is pulled, it opens the door to a chute for the books.

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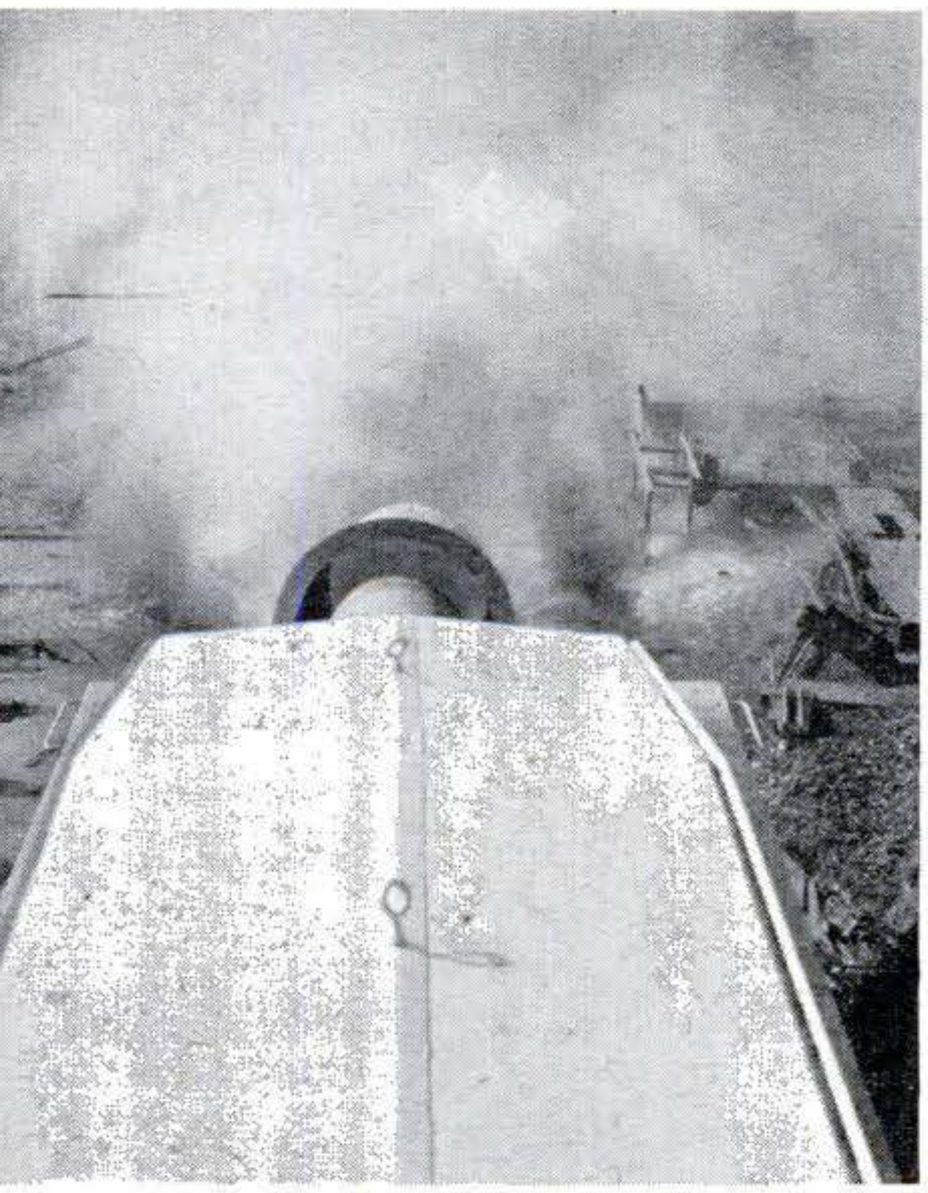
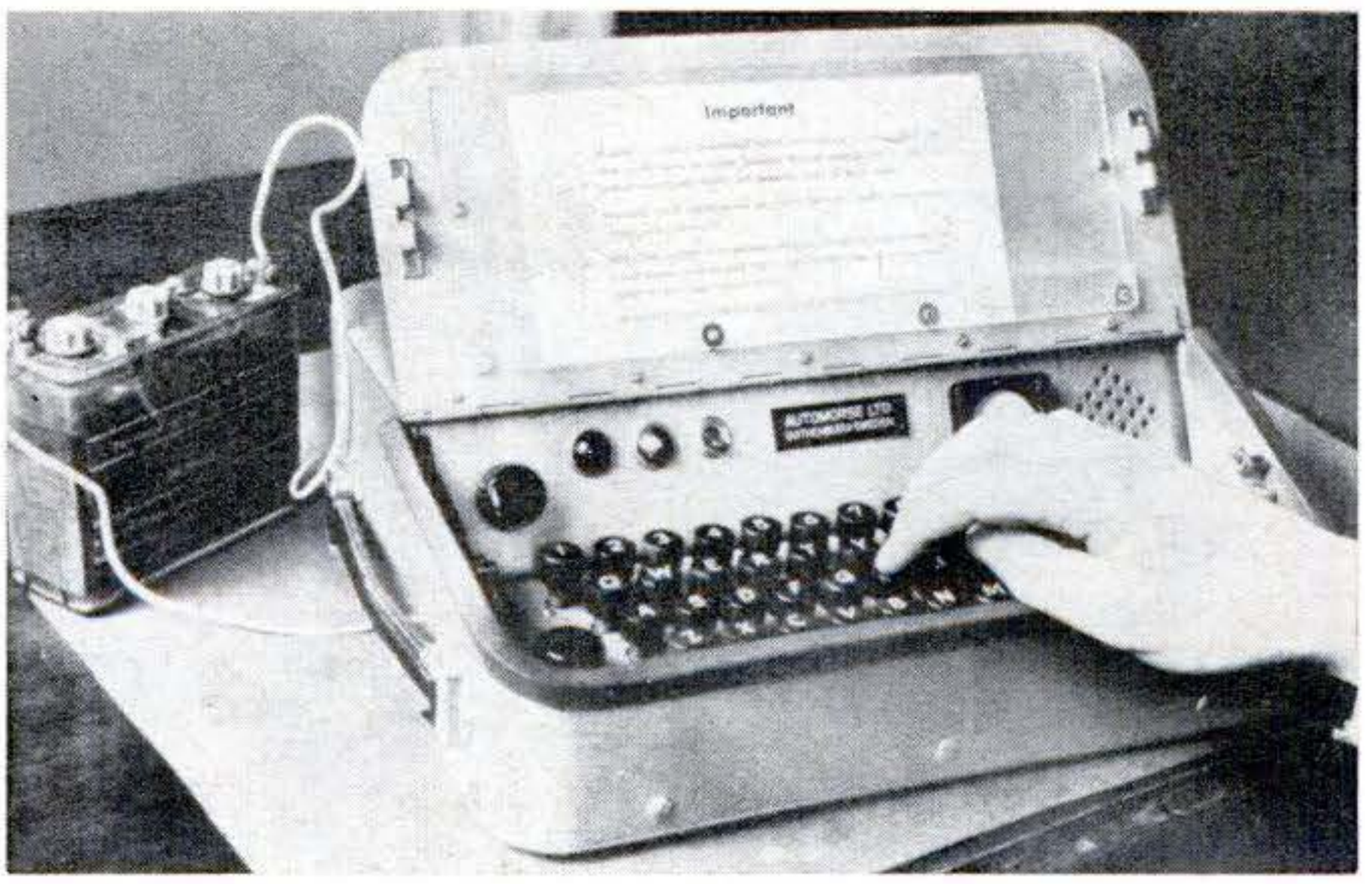
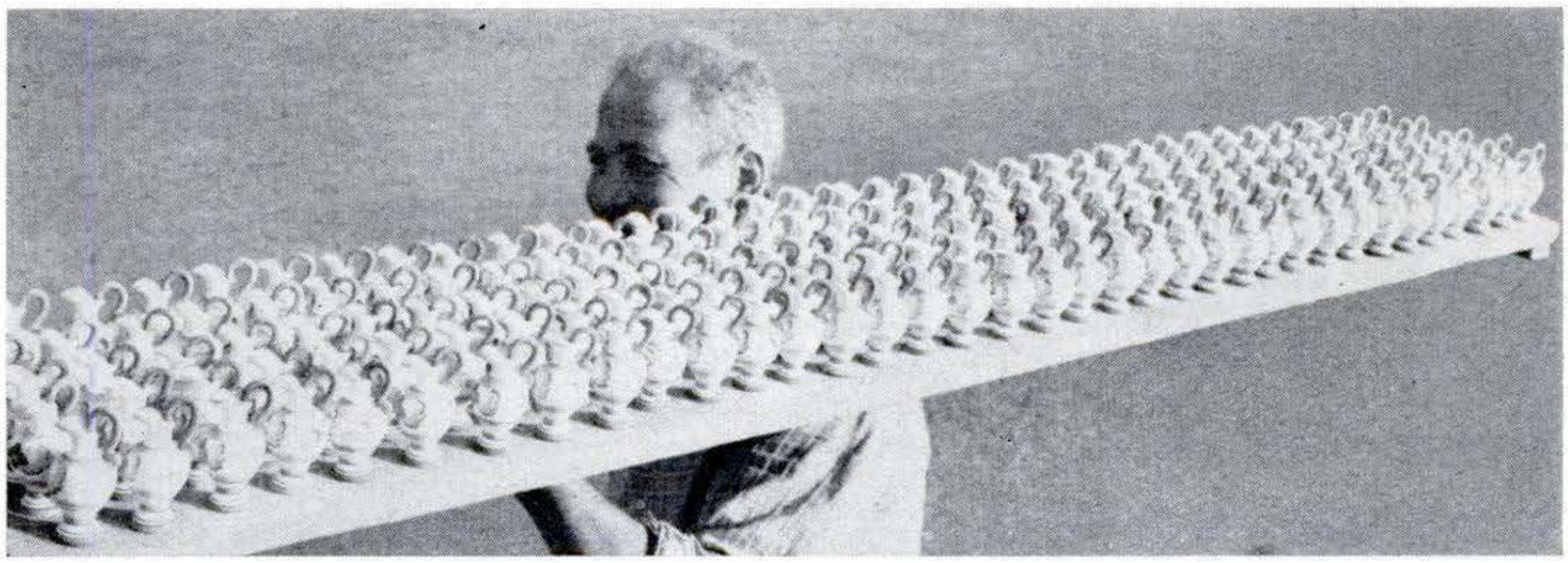


. . . blasts ahead, both sides.



Typewriter sends Morse code

When a key of this typewriter is pressed, the appropriate symbol in dots and dashes is fed to a wireless transmitter. The sender doesn't need to know Morse code. The machine was invented by a Norwegian radio operator, is being installed in lifeboats.



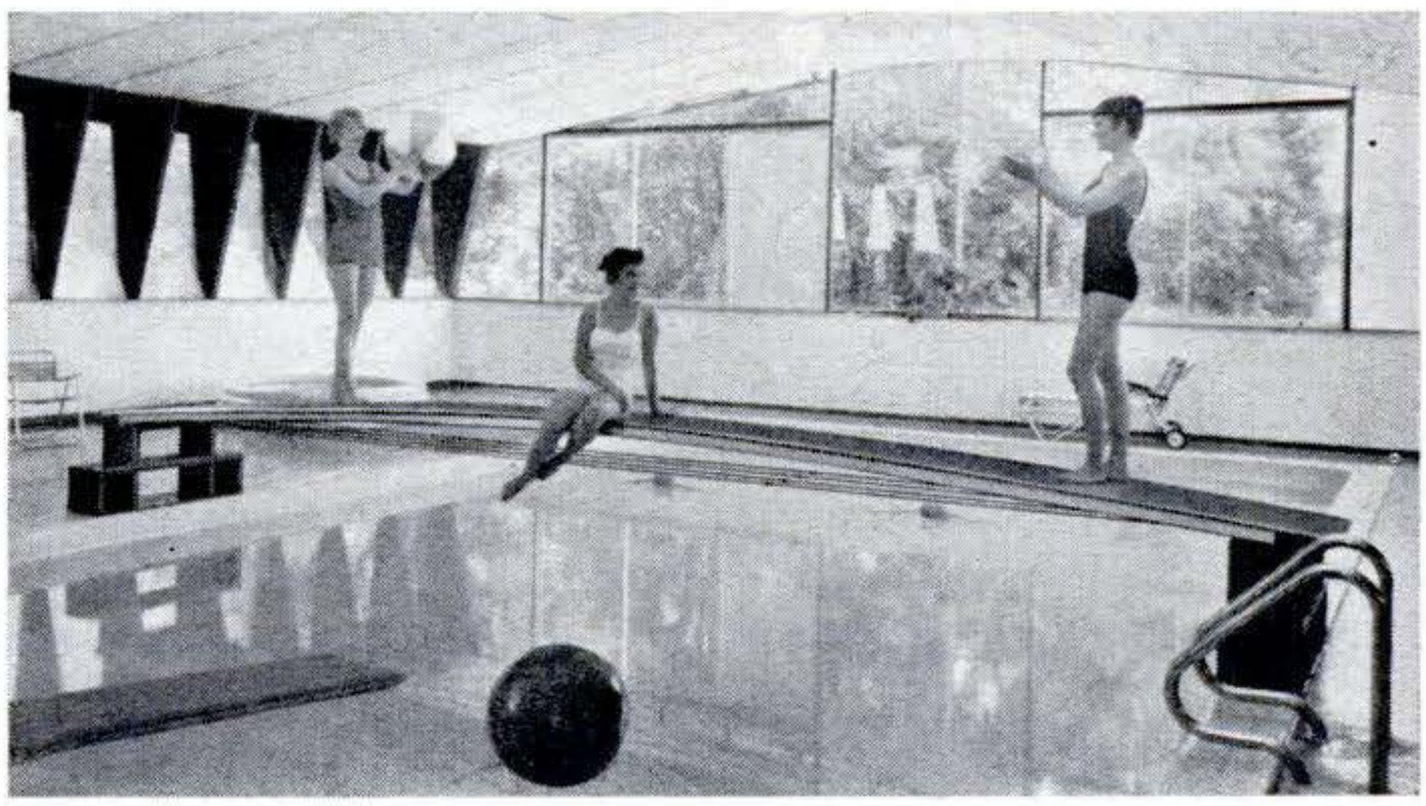
Juggler of fragile jugs

Nonchalantly performing a spectacular balancing act, the workman above shoulders a plank holding 183 tiny jugs. The feat calls for steady nerves, but it is a common method of delivering pottery products in the small Italian town of Derruta where the manufacture of fine ceramics is the main industry.

Bridged pool

One way to cross a swimming pool without getting wet is by bridge. This one is aluminum, supported by tie rods made by Kaiser for concrete-form construction, and decked with plywood.

Williams Form Engineering Corp., Grand Rapids, Mich., provides it as the extra ultra for swimming pools that have everything else.



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How Deadly Is the Black Widow Spider?

By Gardner Soule

"THE most feared and dangerous spider," Willis John Gertsch said to me, "is the black widow. Its venom is probably the most poisonous among all venomous creatures."

Gertsch ought to know. Curator of Spiders at the American Museum of Natural History in New York, he's probably the only man in North America who has made spiders a full-time job for 25 years. In his office, surrounded by glass vials of specimens in alcohol, he gave me the answers to a lot of questions:

Q ***Where do you find black widows?***

A "In every state except Alaska. In Death Valley, and in the Rockies as high as 8,000 feet. In wet, humid, or dry sections of the U. S. Where it's hot and where it's cold. The black widow has been able to survive under any condition that exists in the States or in southern Canada. She also flourishes in the West Indies and even penetrates into South America."

Q ***Is there an area where they are especially prevalent?***

A "California is where they have most bites a year. On the average about 60 bites a year have been reported in this country. California reported almost half; Virginia was next; Florida, third. Very few bites are reported from such northern states as Maine, Vermont, and Minnesota."

Q ***What makes the black widow so dangerous?***

A "Her venom. You will notice I say 'her.' There is no proven case of the male of the black widow ever biting a human being. We don't know if he does. Anyway, he is only one-third as large, and his fangs might not penetrate your skin."

Q ***Can you describe the venom?***

A "All but a few kinds of known spiders produce venom. It's a colorless liquid with the consistency of a light oil, and is said to have a bitter taste. The black widow's venom is one of the very few virulent ones. Ounce for ounce, it's 15 times as potent as rattlesnake venom."

Q ***What are its effects on humans?***

A "The first thing you feel is a sharp little sting—like the prick of a needle. Soon after there are acute pains, which reach their maximum intensity in most instances within half an hour. They last a few hours. The pains are violent, excruciating. They may be continuous or intermittent. The pain spreads gradually from the wound to other parts of the body, and finally concentrates in the abdomen and the legs. The abdomen becomes rigid, stiff as a board."

Q ***How does the poison work?***

A "The black widow's venom is neuro-

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toxic—it acts on your nerves. (Rattlesnake venom is a blood poison.) It causes nausea, vomiting, faintness, dizziness, tremors, shock, and speech disturbances. Sometimes the victim has difficulty in breathing."

Q ***How can you be sure you've been bitten by a black widow?***

A "The fangs are only a fiftieth of an inch long, so you may not see the tiny red marks. The sure way is to see the spider biting you. If you can, you should preserve the offending animal—its remains, that is—for an expert. Otherwise, you're just guessing."

Q ***How can you tell it's a black widow?***

A "She's a jet-black spider with blood-red markings. She looks like an old-fashioned shiny shoe button—and is sometimes called the shoe-button spider. A very handsome spider. She has that red in the shape of an hourglass on her ventral (under) side. The hourglass marking (which only rarely is missing) is certain identification."

Q ***How big are they?***

A "This one I have here measures a little less than half an inch long. They grow to half an inch."

Q ***What should you do if you see someone bitten by a black widow?***

A "Get him to a doctor as quickly as possible. Complete rest for two or more days is necessary. The doctor will probably treat the patient for shock. In addition, there is a serum—a specific antivenom that neutralizes the venom in 30 to 60 minutes, and reduces the convalescent period and the mortality rate."

Q ***How many persons die from black-widow bites?***

A "Of known victims, something less than five percent have died. I personally think the mortality rate is smaller because I believe many people who are bitten by the black widow never report it—the effects are so slight."

Q ***It's very rarely fatal, then?***

A "Very rarely. Deaths are usually among infants, the old, or those who are already infirm or ill. One reason is that the spider ejects her venom from two poison sacs in her head, and that's all there is. There's rarely enough for a fatal dose for a healthy adult. Besides, she may bite you right after she's expended her venom on a fly or some other insect, and so may not have enough left to greatly affect you."

Q ***If you recover, are there any lasting effects?***

A "None."

Q ***It's not so serious, then?***

A "I didn't say that. It's an experience to be avoided. In capturing black widows, I pick them up carefully with forceps. Then I pop them at once into a glass vial, and plug it tightly with cotton. That lets air in. She can go a long time—a matter of months—without food and water, and still live."

Q ***Have you ever been bitten?***

A "No, but my boy had a near miss while hunting harmless spiders with me when he was five or six. I'd roll over a rock, he'd pick up the spider and put it in my glass jar. Then one time he picked up what I instantly saw was a black widow. My heart stood still. He popped her into the jar before she bit. I wouldn't like to go through that again."

Q ***Where does the black widow hide out?***

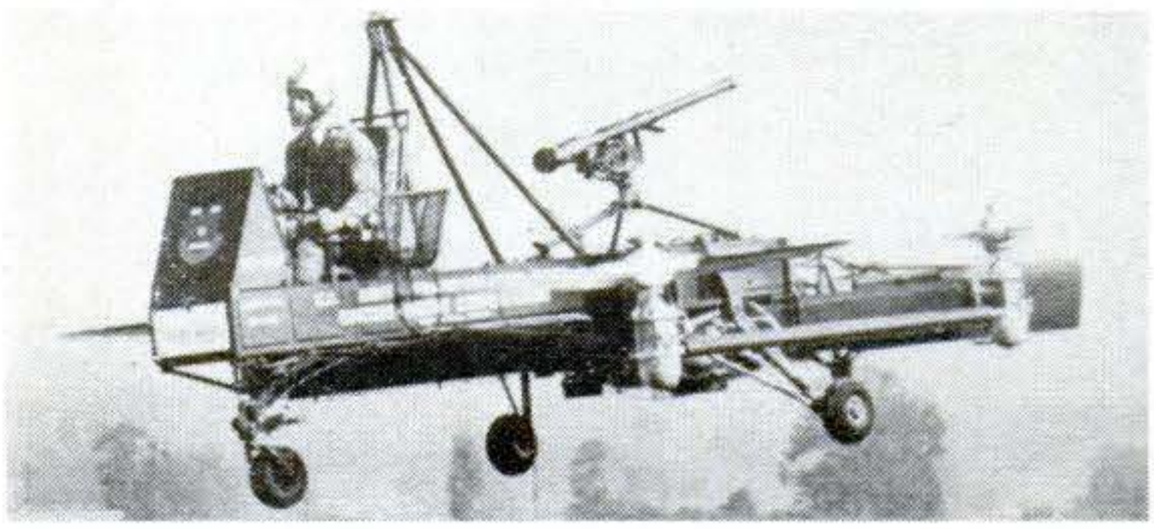
A "In littered areas or dumps. Under chips of wood, log piles, heaps of stone.

[*Continued on page 231*]

HEAD OF FEMALE shows fangs that make twin punctures in skin of victim. Black widow's venom is 15 times as potent as a rattlesnake's.

Tunnel for power

This tunnel-like steel frame will house the world's biggest generator, a 384,000-kw. giant being constructed by Westinghouse for a new power station near Helena, Ark. The cylindrical housing is 14 feet in diameter and 30 feet long. It will be installed by the Arkansas Power & Light Co. during the summer.



Ground hopper

The aerial platform at left is Curtiss-Wright's version of an Army flying jeep [PS, May '58]. It's a low-flying vehicle intended to follow ground contours and evade enemy observation. The VZ-7AP is powered by a 425-hp. turbine that drives a rotor at each of its four corners. Pitch of blades controls direction.

Mobile auto school

A fleet of 35-foot trailers has been equipped as service classrooms for training the mechanics employed by Rambler dealers. Each contains benches for 12 men to adjust axles, transmissions, and other parts. After class sessions, a tent is set up at the rear for actual work on a car with built-in malfunctions.

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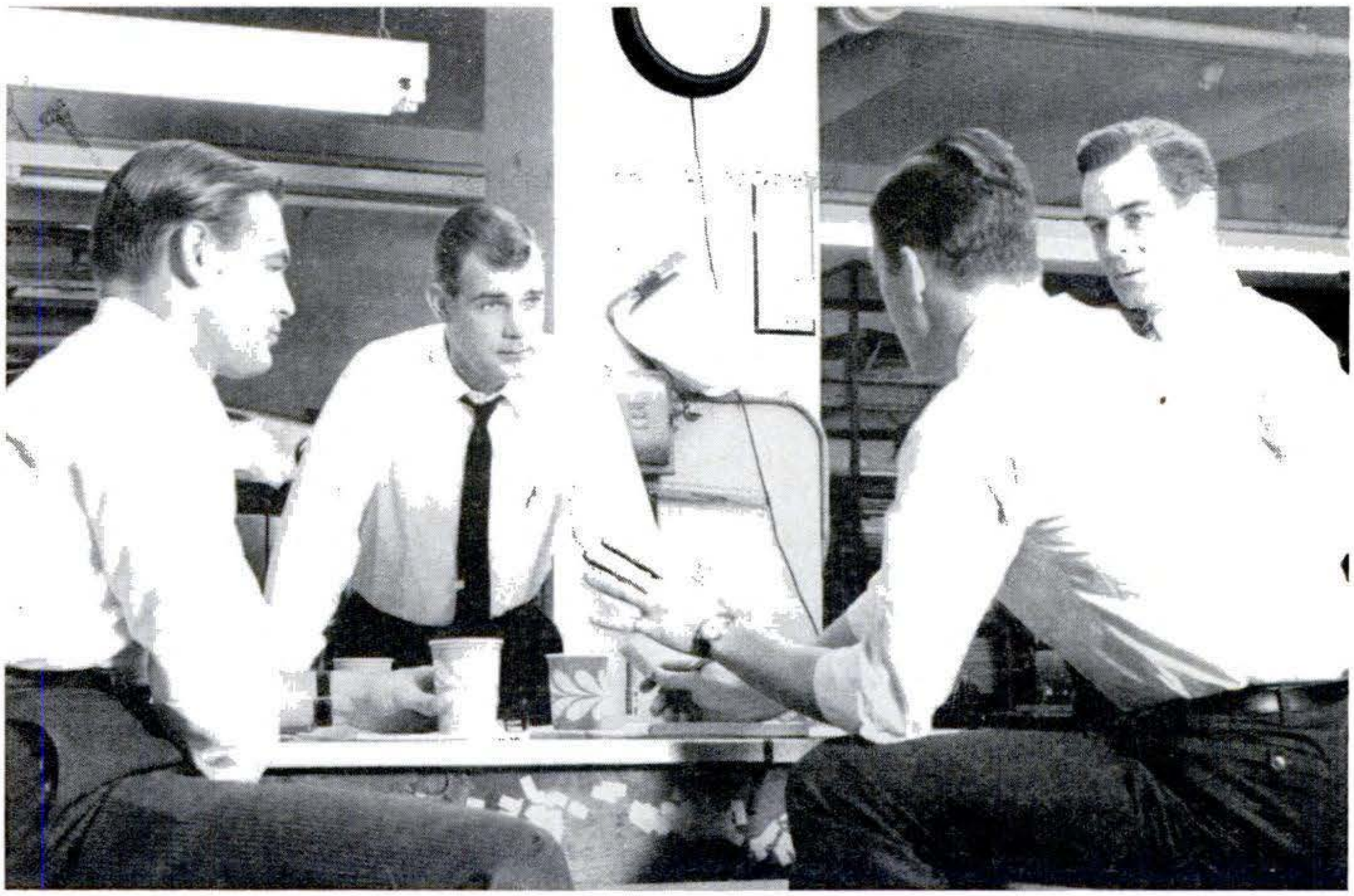

Secrets of Working with a Group

The success or failure of people you work with rubs off on you. Here are some tricks to remember—and pitfalls to avoid

By Max Gunther

GROUP dynamics is the high-class name for one of the most down-to-earth skills ever invented. It is one that you can use every day to boost yourself toward a better job and more pay.

Today the man who truly works alone is as rare as the itinerant tinker. In shop, lab, plant, or office it's the crew, the team, the gang. A group of men designs the plane, taps the blast furnace, builds the house. After hours, it's committees, committees, and more committees—for your church, the Boy Scouts, American Legion, bowling league, and school board.

There are good reasons for the let's-work-it-out-together scheme:

- Many problems are too complicated, or too interrelated with other problems, to be solved by one man alone.
- More people than ever are working for large organizations, where systematized group planning is the "way things get done."

Many thoughtful people object to this accent on the group, seeing in it a surrender of traditional American individualism and a loss of creative ideas. Still, team work is one of the facts of modern life. And like it or not, you may have to get along with it. If you're in a successful group, you'll be marked down as successful—and the opposite is likely to be just as true.

"Joe? He's a good man," the boss may say. "That gang got the press back on the line *before* the new parts came in." Or he may say: "Can't be sure about Joe. He was in the bunch that got all those order sheets mixed up."

Does this mean you're helpless—that

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How to keep the ball rolling when you work with a group

SUPPORT THE "TASK LEADER," the man with ideas, who's ready to talk and listen. He may rub others the wrong way, but he's valuable.

RECOGNIZE THE PERSONAL NEEDS of the men in your group. Give the henpecked guy a chance to work off his pent-up aggressive drives.

LOOK FOR THE "SOCIAL LEADER," the best-liked man who's needed to smooth down any feathers ruffled by the blunter "task leader."

URGE THE QUIET ONES to speak out. They may hold back good ideas simply because they are afraid of offending others in the group.

your future may be decided by team work that you cannot control? Not at all. The research psychologists have uncovered fascinating—and startling—facts about what makes teams tick. You can use their findings to steer your team toward a job well done—even if you are not the appointed leader and cannot choose the men you have to work with. The important thing is to sense the forces (often they're hidden) that affect your group's performance. Here are some examples you can use when you're on a team.

The men

You can't always pick the men in your crew, but sometimes you can influence the selection, or at worst, count yourself out. Harvard psychologist William Schutz has worked out some guides to choosing. He classifies team members this way:

Personal: Easy-going, works well with others. Strikes nice balance between getting job done and avoiding friction.

Overpersonal: Wants to be liked. Sensitive, easily offended. Makes personal issue of ordinary argument.

Counterpersonal: Thick-skinned, wants to get job done. May be coldly efficient or gladhander, but avoids close personal ties.

Dr. Schutz found that you can organize a compatible, effective group with three combinations: (1) all personals, (2) personals and overpersonals mixed, or (3) all counterpersonals. When Dr. Schutz made up compatible and incompatible groups by this formula and tested them, the compatibles outperformed the incompatibles nine times out of 10.

You can follow Dr. Schutz's guides too far. Men who work well together make the best team—but too much congeniality in the gang can easily prove a handicap. Some differences of opinion are stimulating. And varied backgrounds are valuable, bringing wider experience and fresher viewpoints to bear on your job.

The right *number* of men for an efficient working group has been established by careful experimentation—never *more*

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Steer clear of these roadblocks that can stall the job

than seven and never *less* than four.

Harvard's Dr. Robert F. Bales observed that as many as seven men could talk to each other at a meeting. If there were more than seven, some pairs of men were cut off from each other—they failed to communicate. This, he says, can break the exchange of ideas and splinter the team into separate subgroups.

Why no fewer than four men? Because in a three-man group, you may find two ganging up on the other. A minority of one can be so cowed that he might as well not be there at all.

At Swarthmore College, psychologist S. E. Asch worked out a series of devilish tests in which groups were asked to guess at the length of a penciled line. Before each test, all members of each group except one man were secretly instructed to make the same wildly wrong guess.

In one-third of the cases, the lone man rejected what his eyes told him and went along with the majority. But when there were two against a majority, the lonesome partners were pressured into wrong guesses only about one-tenth of the time.

The size of your crew is something you can often change. If there are more than seven, ease somebody out (or quit yourself). If there are fewer than four, try to enlist more.

The leader

You think every group needs a specifically designated leader? Modern research says you may be wrong. Psychologist Thomas Gordon found that a group often works best when the whole group leads. If it starts with an appointed leader, Gordon says, it can reach top effectiveness only when the leader is absorbed into the group as a plain member—a fellow who can be argued with like anybody else.

A crew leading itself doesn't feel that one man—the leader—will get most of the blame or credit for what the group does. Each member has a big stake in the group, and internal conflicts are kept down.

Act as a plain member if you're named

DON'T GET INTO A THREE-MAN GROUP. Two of the men may gang up on the third, and a minority of one doesn't stand much of a chance.

DON'T MIX WRONG PERSONALITIES in your group. Thick-skinned, efficient "counterpersonal" types work well only with others like them.

DON'T PRESCRIBE FOR THE GROUP exactly how its job should be done. The members should feel free to work out the assignments for themselves.

DON'T LET SPEECHMAKING RUN ON and block your job. Be brief yourself. And—firmly—interrupt others who threaten to talk all night.

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leader of a group. Let the others know that you can be argued with, and that the only rules you'll make are those imposed from outside the team—rules set up by the company, for instance.

What happens most often in a self-propelled, leaderless group, says Harvard's Dr. Bales, is that two leaders arise. (You may be one of them—but if you aren't, don't fight it too long, or you could wreck the nicely balanced mechanism that's starting to form.)

One of these leaders is the "task leader." He talks and is talked to more than any member. Other members usually consider him the "man with the most ideas." He is less likely to be the "best-liked man." He stimulates other members, can't help creating friction and tension.

To balance him, a "social leader" arises. He's usually the "best-liked" member of the team. His function: to smooth down feathers ruffled by the task leader. The two men work in close harmony; there's more communication between them than between any other two members.

If you're in a group where the appointed leader is the "wrong" man, try to show him what's happening. Point out the task and social leaders who are struggling to arise. If the appointed man clutches his power jealously, there's little else you can do. With luck, the group may still stumble to its goal—but the journey may be painful.

If you're appointed as leader and want to hold the post, or if you see yourself rising to leadership in a freewheeling group, make sure you know which leader you are—task or social. Then watch to see who's rising as your partner, and carefully make an ally of him.

Whether you're leader or member, it helps to let the whole team see who the leaders are and what their functions are. You might do this by making side comments: "Ever see an idea man like Joe?" or "Lucky thing we have Pete, or we'd all blow our tops."

The job

Maybe you think that the Plant Parking Committee has only one goal—to assign parking places. Not so. It must do other things as well, and these *unstated* goals often cause trouble.

Every group has to fulfill the personal needs of its members, needs they don't face up to themselves. Fellow on your left doesn't get enough attention from people in his daily life, seeks it by talking long and aimlessly. Smith is henpecked at home, tries to work off pent-up aggressiveness by bulldozing the rest of you around. Jones wants people to like him, holds back useful suggestions for fear they will provoke hostility.

Recognizing the needs, personal and subconscious, of the men you work with can be very helpful—if you keep your knowledge to yourself and use it to nudge the group toward its proper goal.

Outwit the talkative fellow by getting some things done before he shows up. Or suggest a time limit on debate (loud-ringing alarm clocks are useful in keeping speeches short).

Let henpecked Smith win once in a while, either on less-important points, or

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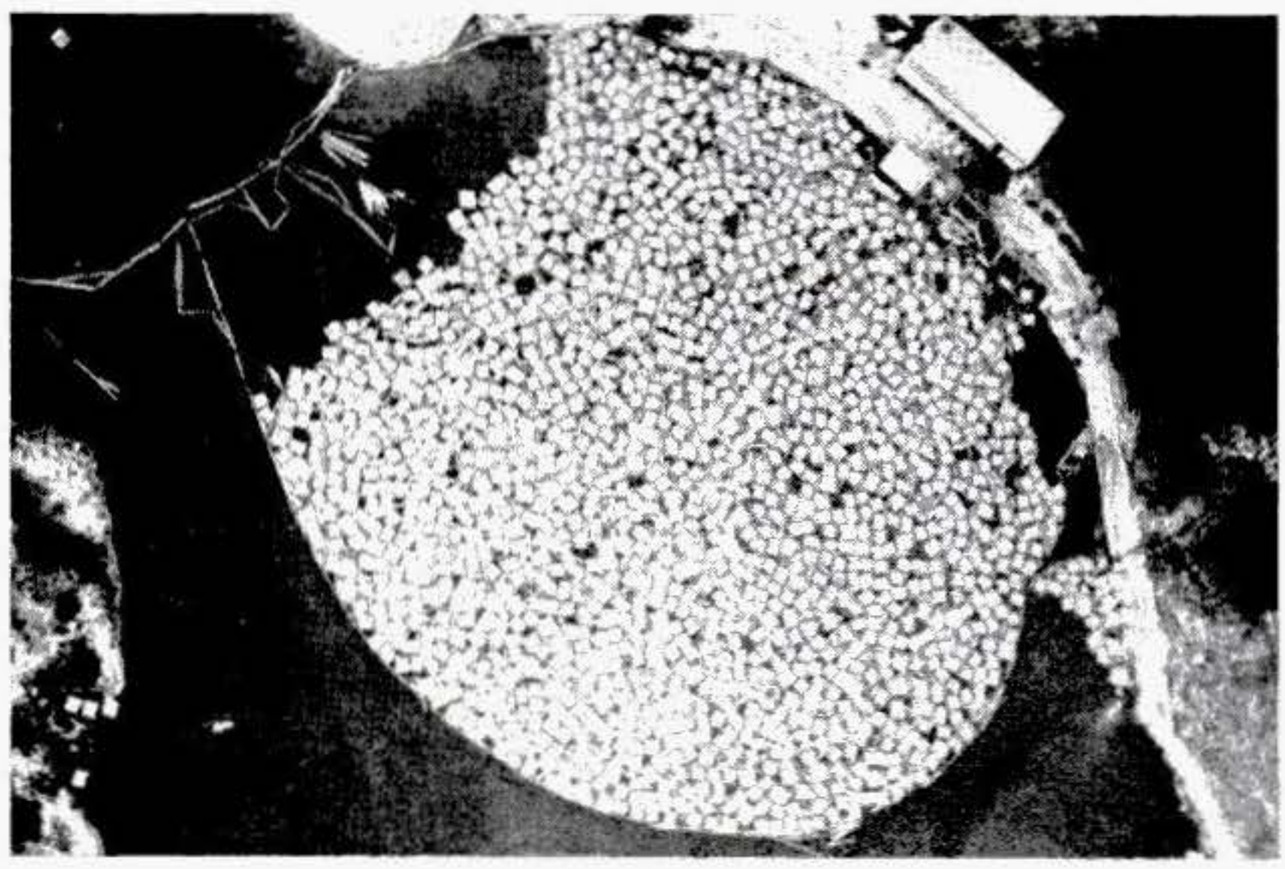
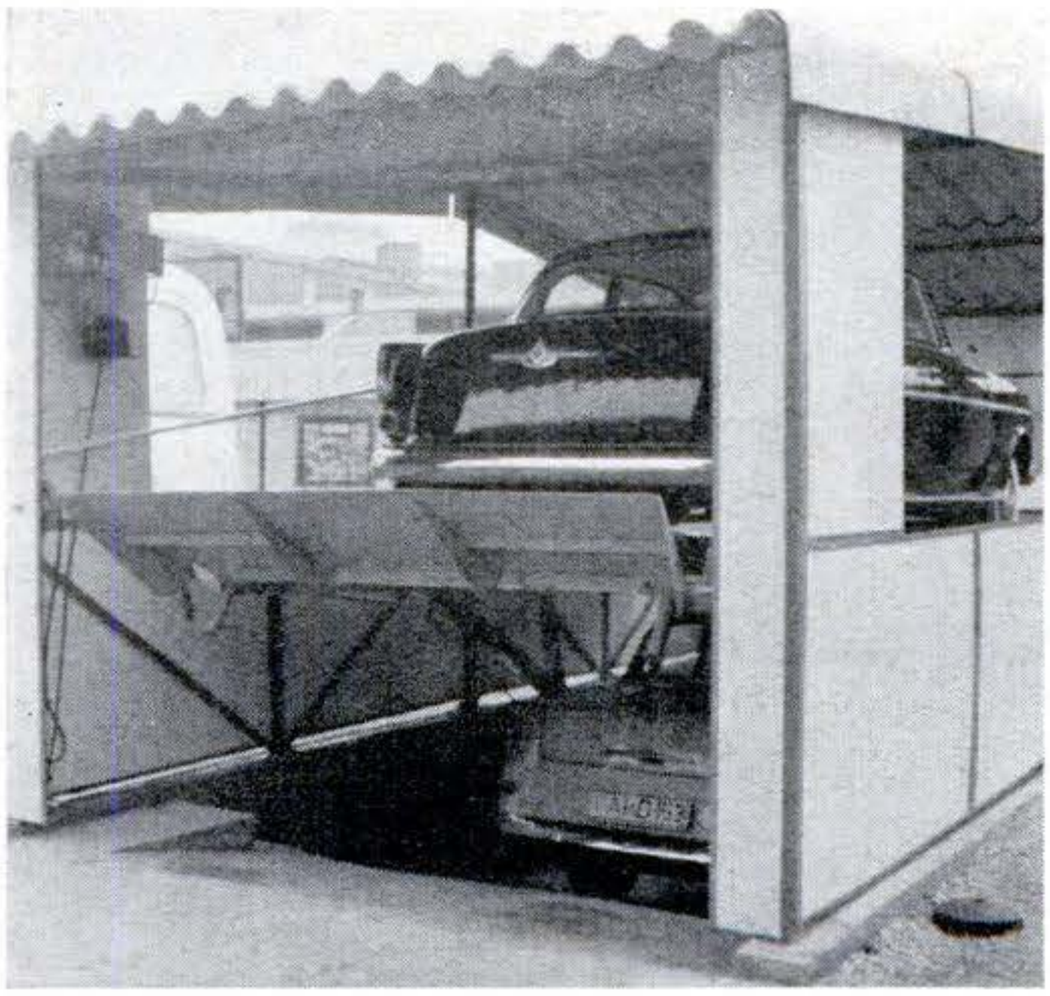


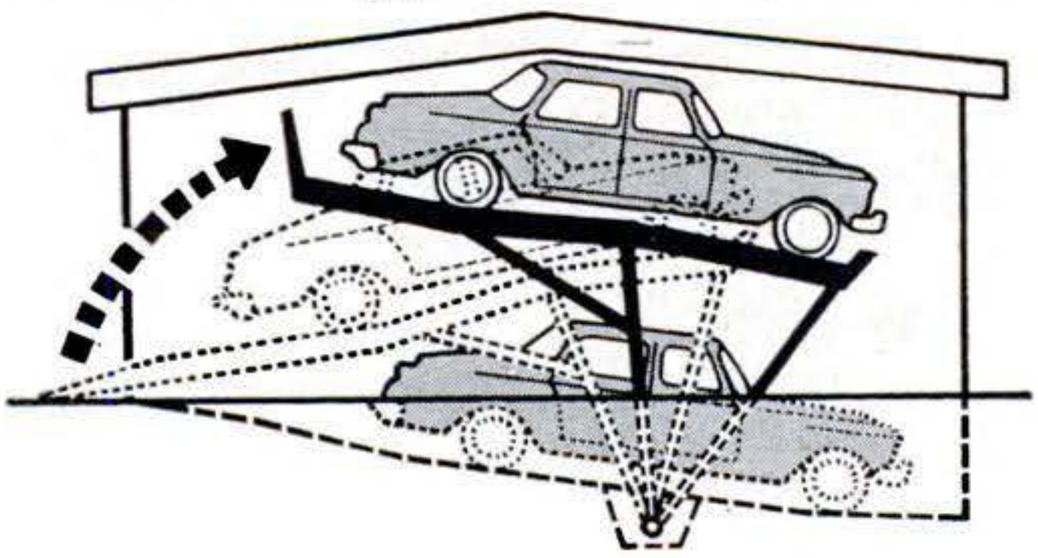
What is this?

Can you tell what's in the picture at left? Check your answer below

ANSWER: It might be a hornet's nest, a bagful of lump sugar, or busy organisms multiplying. But it isn't. It's just a lot of pulp timber bound into bundles, floated downstream, and gathered in one spot by the Tollare Paper Mills of Uppland, Sweden. Enlargements of this helicopter photo were used to prepare an inventory of pulp wood on hand. It's the most efficient system the mill has devised so far.



Two cars fit snugly in the usual space of one.



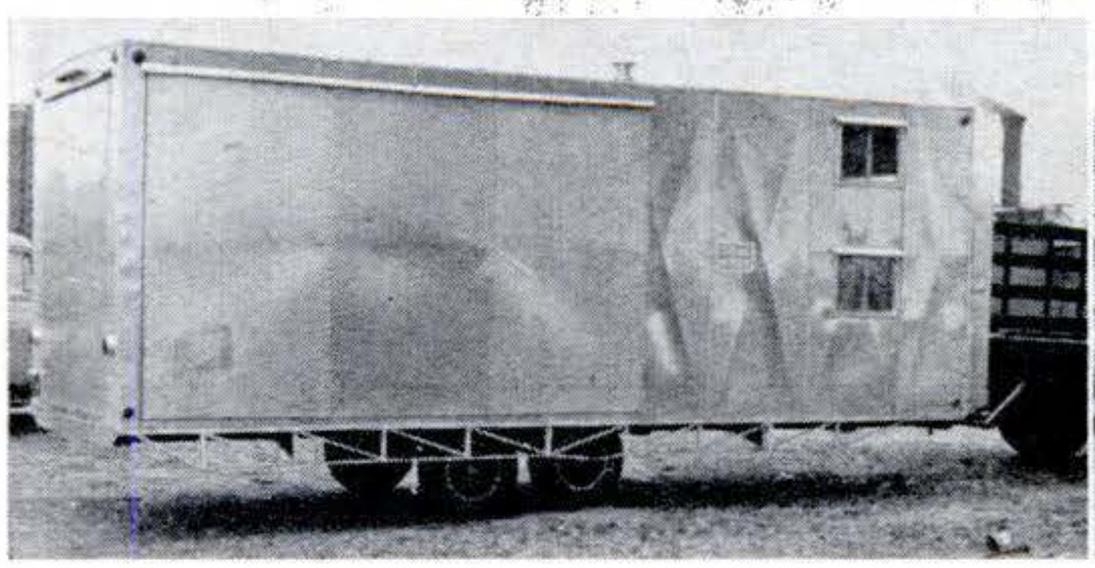
One drives in on a ramp that, when raised, leaves room for another in a semi-basement.

Double-deck garage

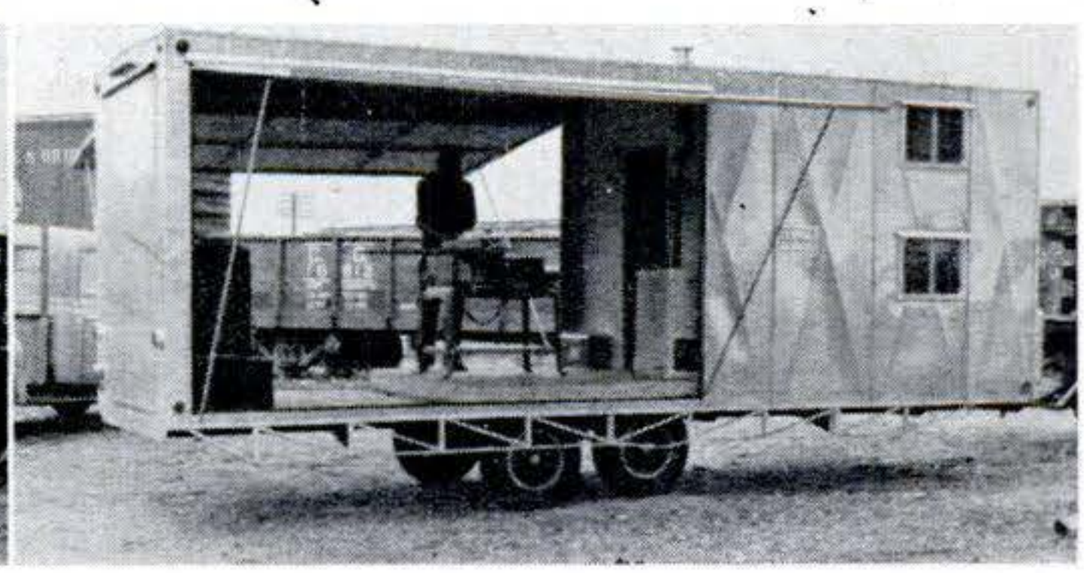
Here's a two-car garage no bigger than one for a single car. The floor of this German unit is excavated on a slant for one. The upper level is a hydraulically tilted channel frame that swings toward the driveway to receive or unload; is angled forward to clear the space below.

Mobile step-stool

The filing truck above can be pushed readily from place to place on casters; when a clerk stands on the step, the casters are locked to the floor. Remington Rand makes it for tiered office filing systems, but its work space would be handy also for books in libraries.



Flaps down, the trailer is set for the road.



Rear is a workshop, front sleeping quarters.

Sleeping on job

When they go on a maintenance job that will take two or more days, members of a bridge and building gang on the Central of Georgia Railway travel in a combination highway trailer. It's half shop and half living quarters. The shop carries tools; the other end has bunks, shower, sink, stove, and electric refrigerator.

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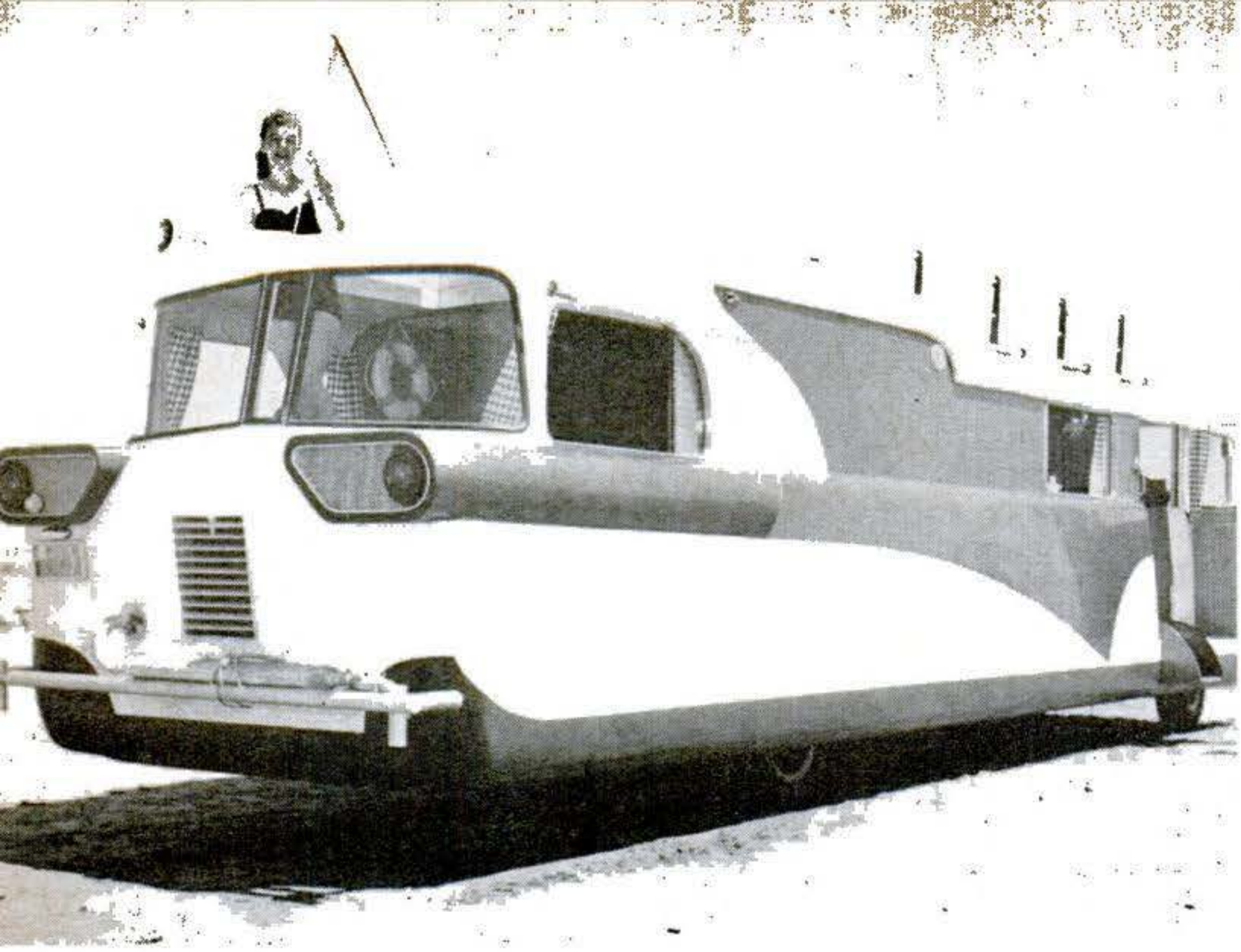
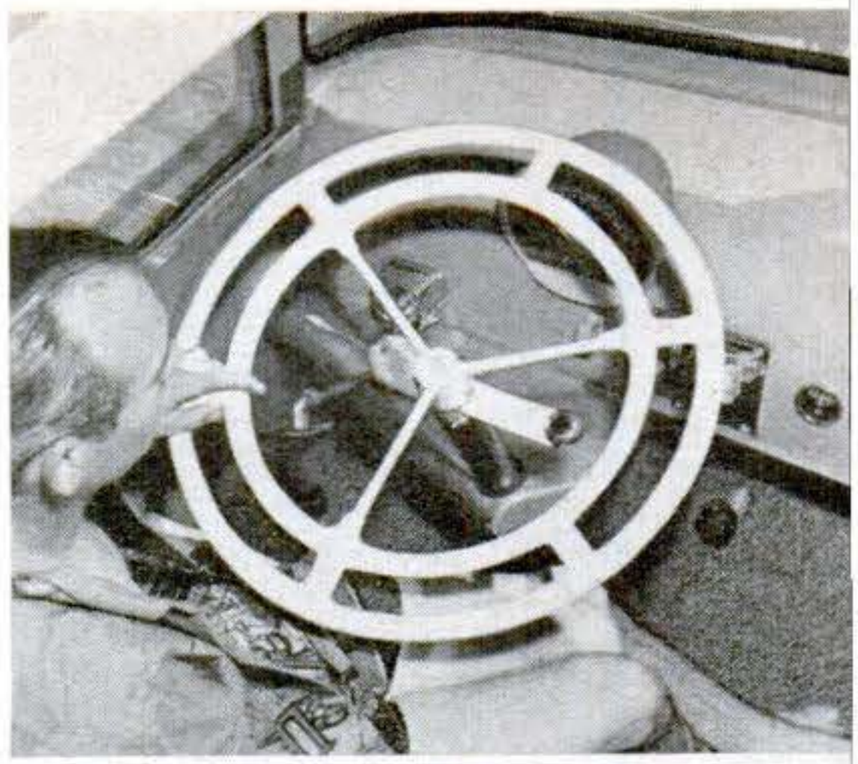


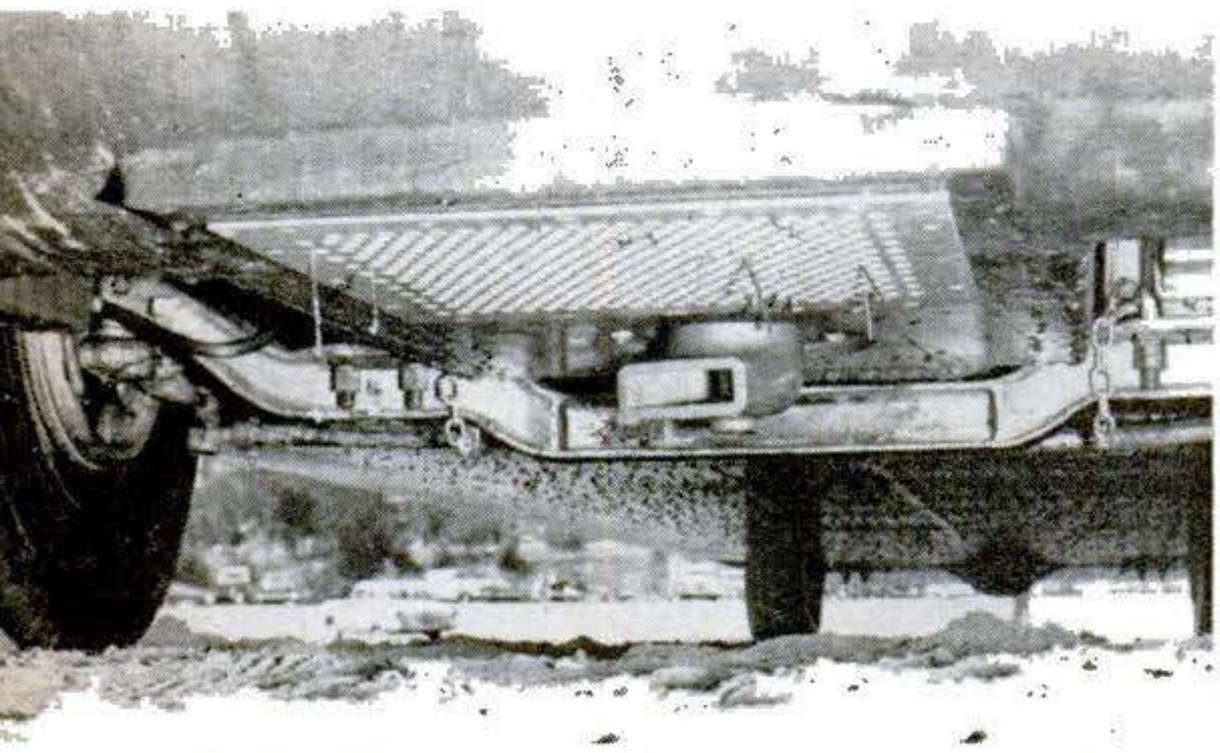


DRIVING ON LAND, Dauphin sits behind an oversize wheel at front end of bus. Afloat, he switches to the rear of bus —which becomes the bow of the cruiser (left). The hatch opens onto a sun deck.

Family Bus Takes to Water

MOST weekend sailors park their car at the water's edge and switch to a boat. But Dorothy and Al Dauphin of Los Angeles drive right into a lake or river with a gentle ker-splash. Their Ann Phibi, a 34-by-eight-foot amphibian, has retractable wheels and a water jet for travel afloat. Inside is a galley, bathroom, and bunks for four.

Al Dauphin, a cabinetmaker, spent $6,000 and four years of his spare time on the land-water cruiser. It's valued at $25,000, but Dauphin doubts that a shipyard would replace it for that.



JET NOZZLE AT THE STERN propels cruiser by shooting out 1,000 gallons of water a minute under 120 p.s.i. pressure. Water is sucked in through the grille by a centrifugal impeller.

A 300-hp. Chrysler engine with automatic transmission drives the vehicle's rear wheels on the highway. Despite its 10,000-pound bulk, the Ann Phibi can get up to 60 m.p.h. on land.

Water speed is about eight knots. Dauphin installed a hydrojet powered by a 60-hp. engine for marine propulsion. The jet nozzle sticks down only 3½ inches below the hull at the stern and can be rotated for steering or reversing direction. A homemade nozzle-position indicator tells where the jet is pointed at any particular time.

Keeping down the amphibian's weight was Dauphin's biggest problem. He cut frame weight by welding together 2¼-inch tubular steel. The hull is only ¼ inch thick on the sides, front, and back; ½ inch thick on top and bottom. Dauphin fiber-glassed ⅛-inch plywood on both sides to make it. Inside, the partitions and other paneling are slabs of Styrofoam sandwiched between sheets of $\frac{1}{16}$-inch plastic.

Al Dauphin built his dreamboat on the flat roof of a building, and had a crane ease it down when it was finished. To celebrate the four years of hard work, he and his wife took a 1,500-mile shakedown cruise across lake-dotted Oregon and Washington.

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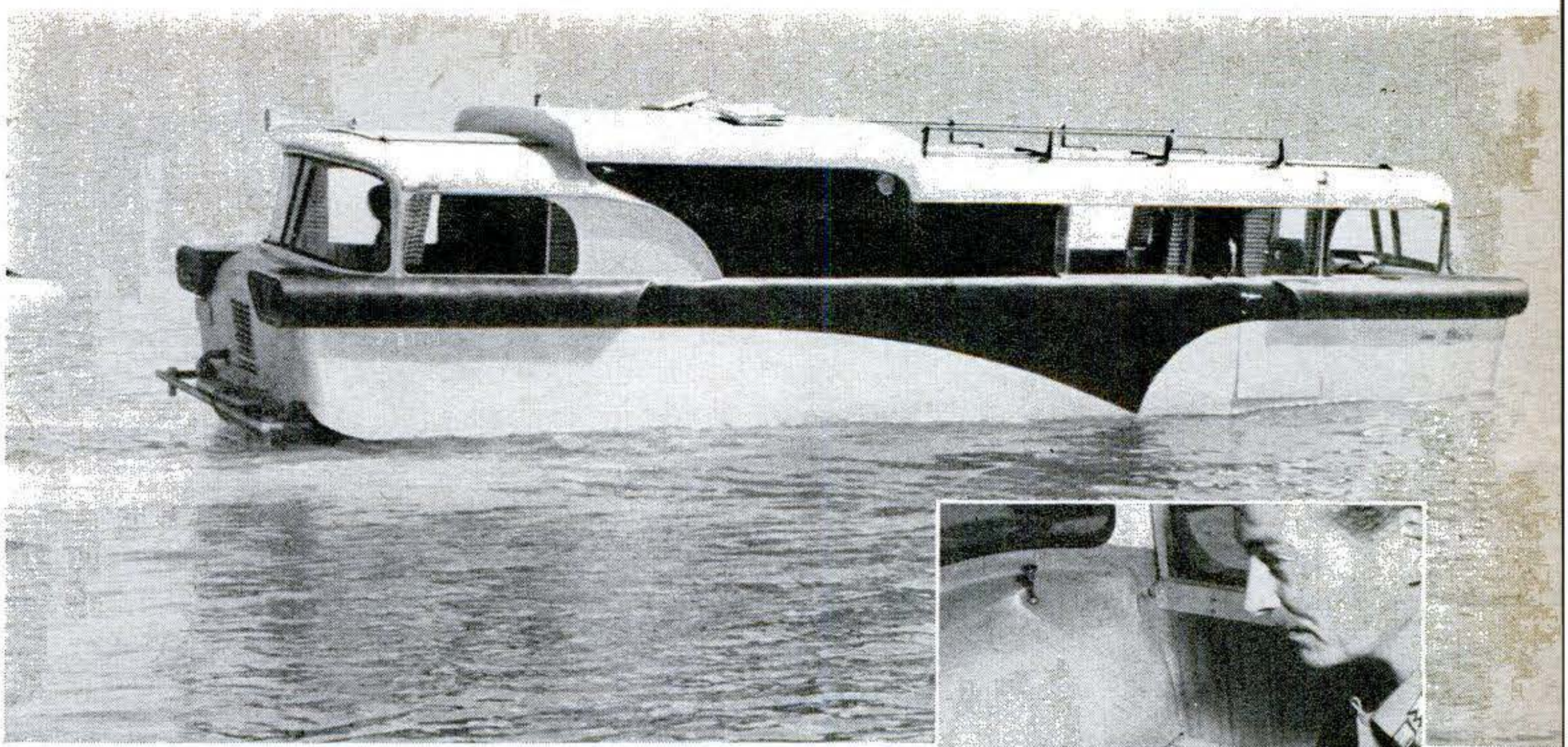
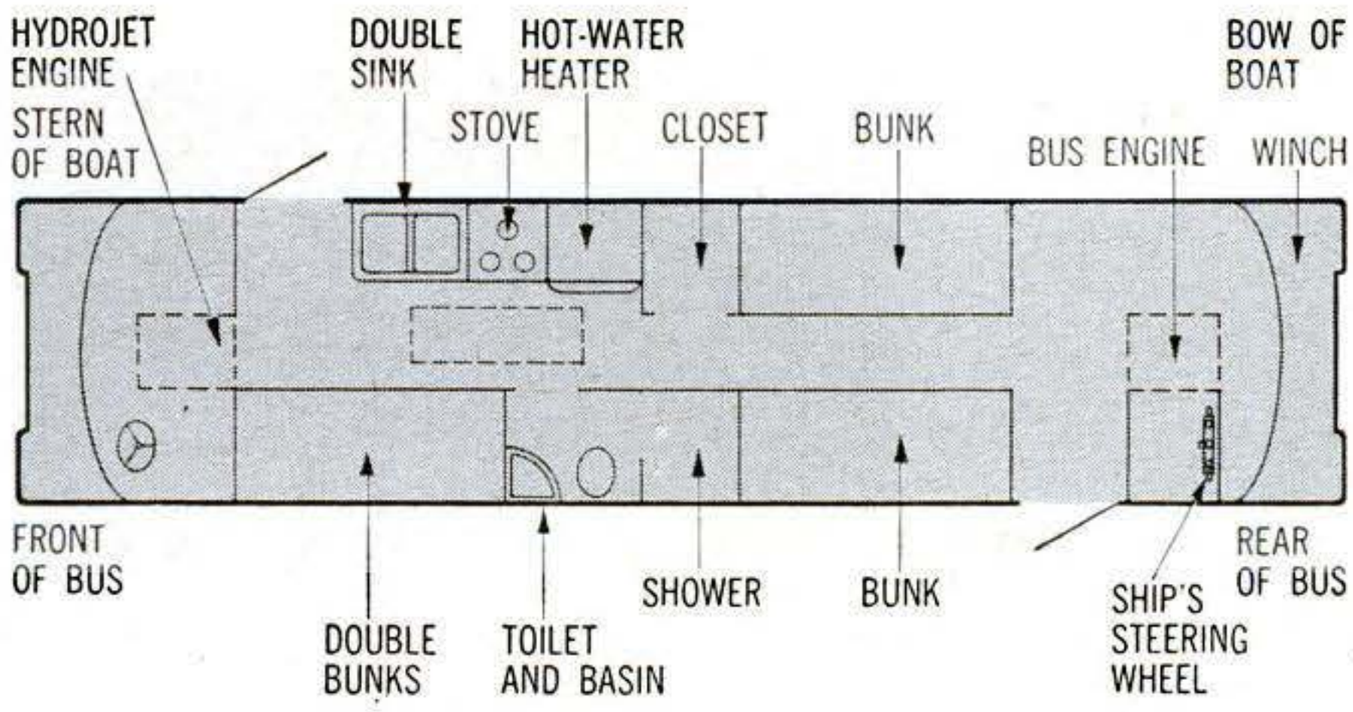
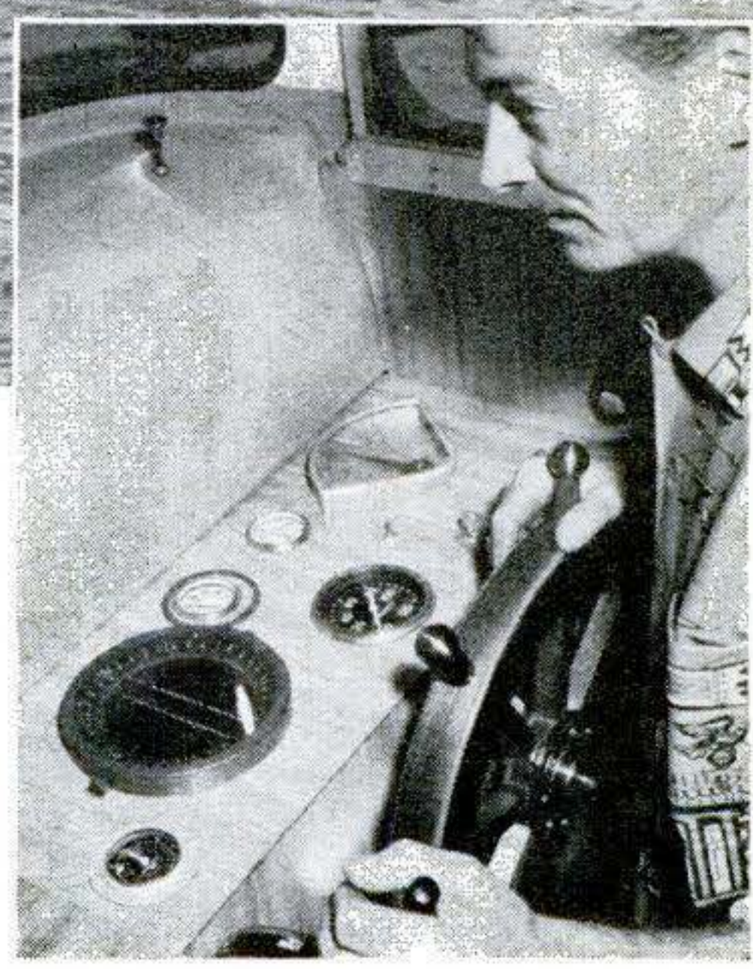
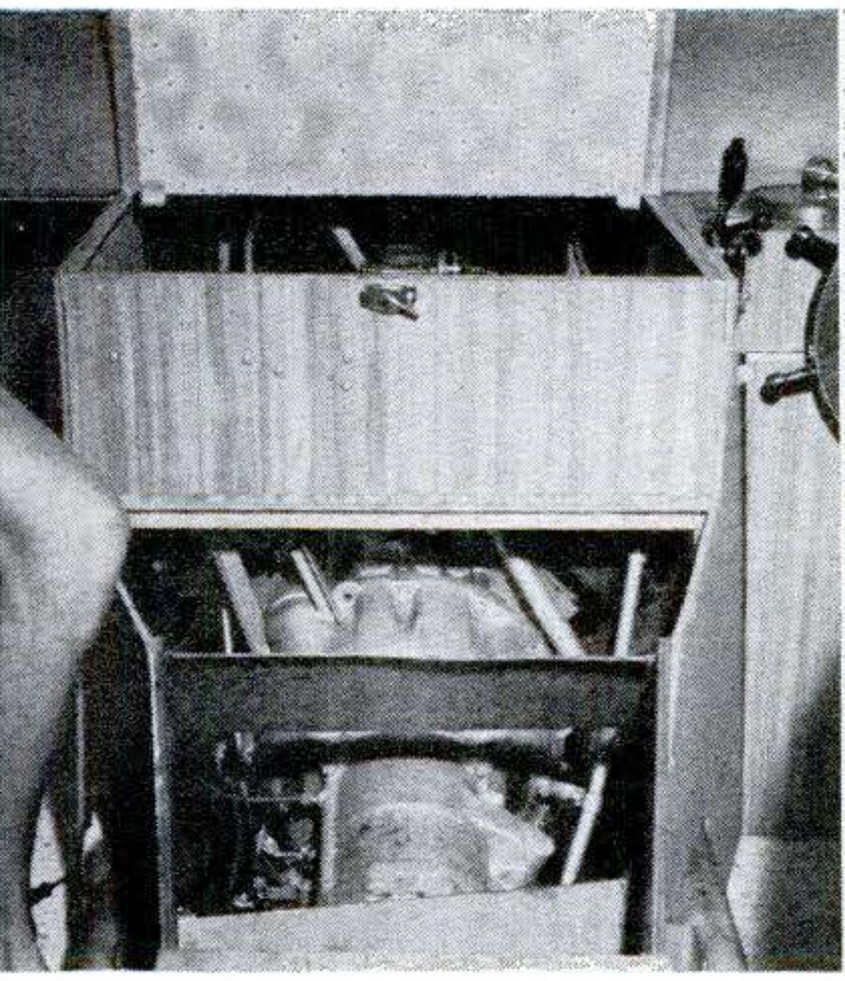


ANN PHIBI DRIVES INTO THE WATER with either end first. She draws only six inches when her wheels are retracted.





STANDING AT THE HELM, Dauphin turns a ship's wheel to steer the jet nozzle under the stern. His left hand works the hydrojet engine's throttle. Largest instrument mounted on panel is a compass.



300-HP. BUS ENGINE is mounted right next to the boat controls and sits over the rear wheels it drives. Cabinet around the engine has hinged panels that open wide for servicing.

DOUBLE-DECK BUNKS are behind driver's seat at the front of bus. Hinged top bunk can swing down to form a backrest for the bottom one. Cabinet behind Mrs. Dauphin hides hydrojet.

KITCHEN WITH A VIEW has a sink with hot and cold water, a three-burner butane stove, and an oven. A 40-gal. water tank supplies sink, toilet, and shower. Outlets carry 12 and 110 volts.

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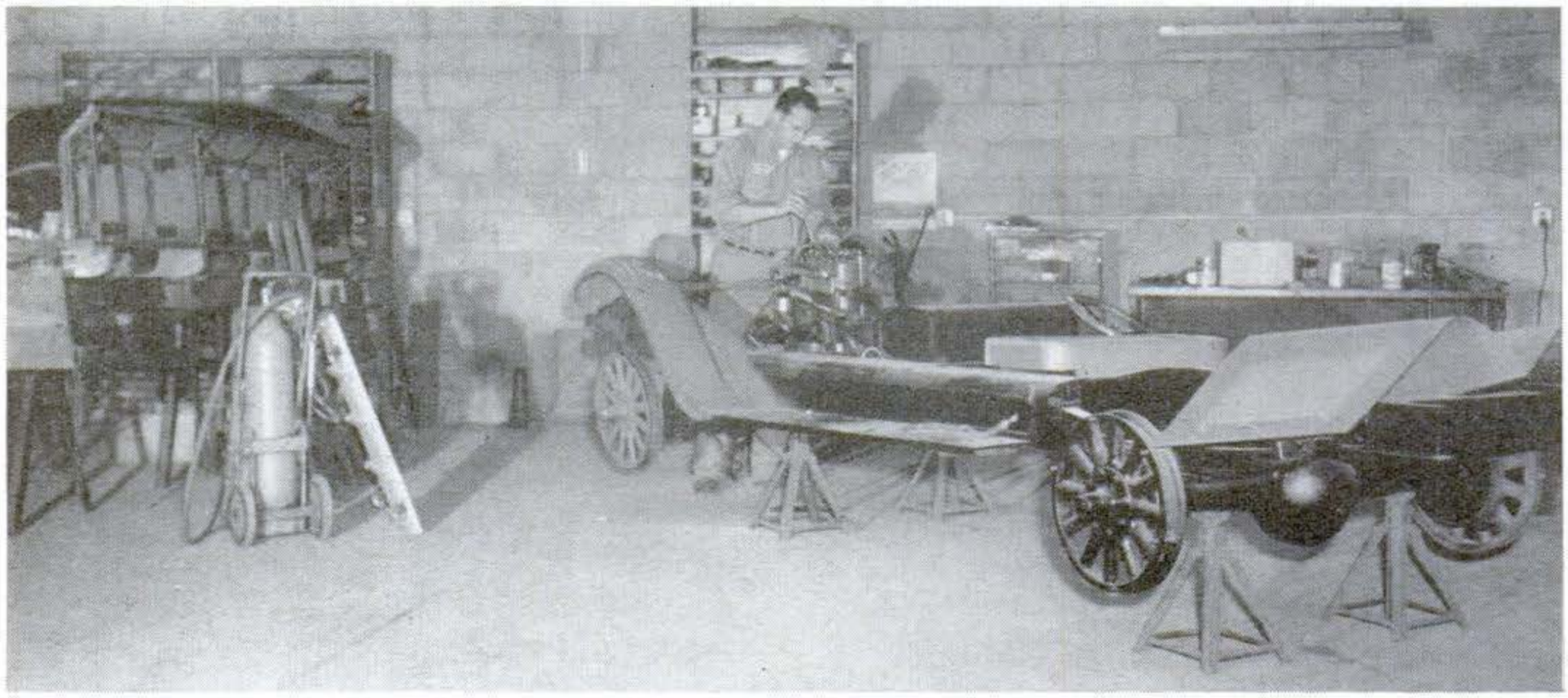
1. Junk yards are a good source.

Nostalgic truckers form

On nights and weekends, mechanics and drivers for the Lyons Transportation Co. put in overtime in a big garage near Erie, Pa. It's headquarters for the Lyons Antique Truck Club, and their work is rebuilding trucks of another day.

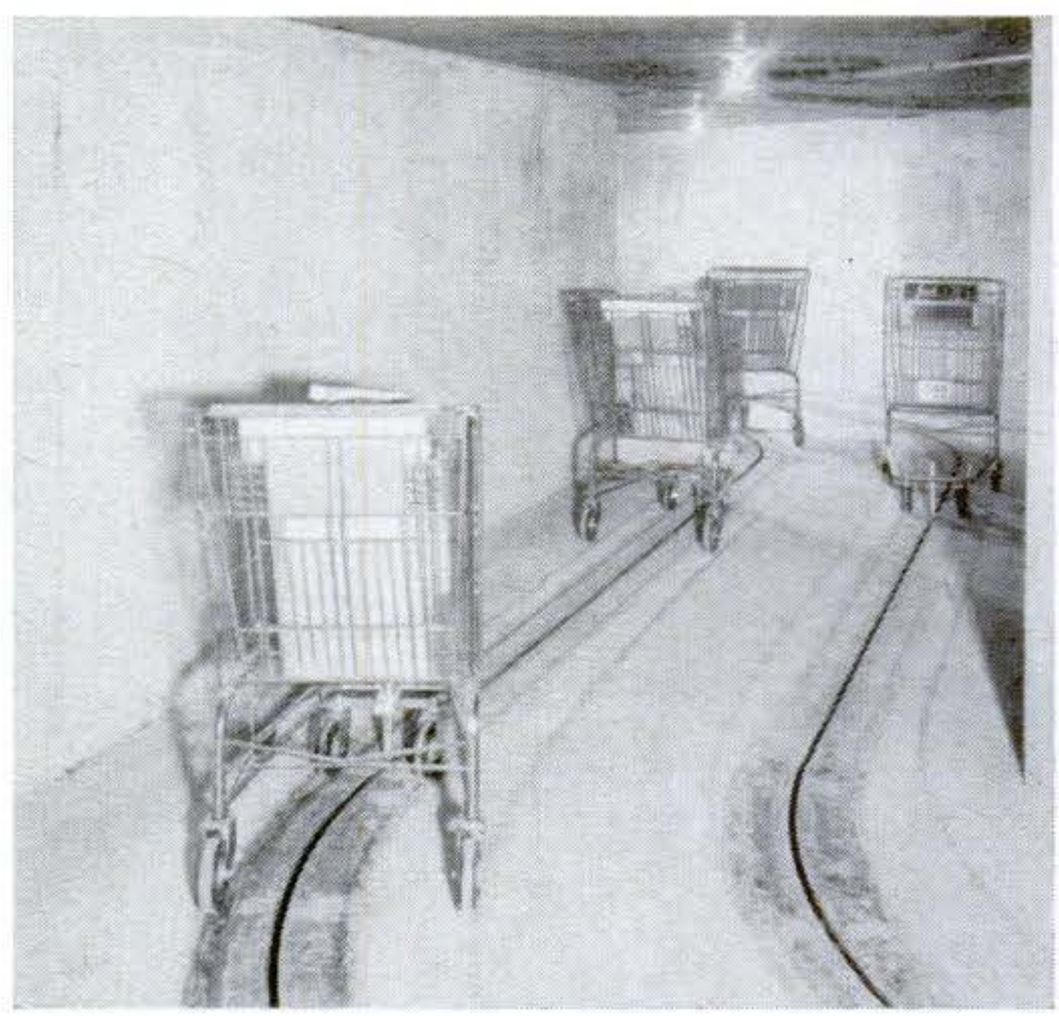
Drivers spot the old trucks in junk yards on their routes. The company buys them and its employees restore them. Members pay dues of a dollar, show the relics in parades.



2. Old-timers, like this '26 Chevrolet, are completely rebuilt with painstaking care.

Slide-rule diagnosis

The two-foot instrument above is a "grouped-symbol associator." It was invented by a London doctor to speed the diagnosis of patients' illnesses, contains enough information to line up symptoms with 337 different diseases.



Pushless shopping carts

These grocery carts go from cash register to parking lot with no human hand on them. Attached to an endless-chain conveyor, they travel a 200-foot delivery passage at a new Joliet, Ill., supermarket and return empty the same way.

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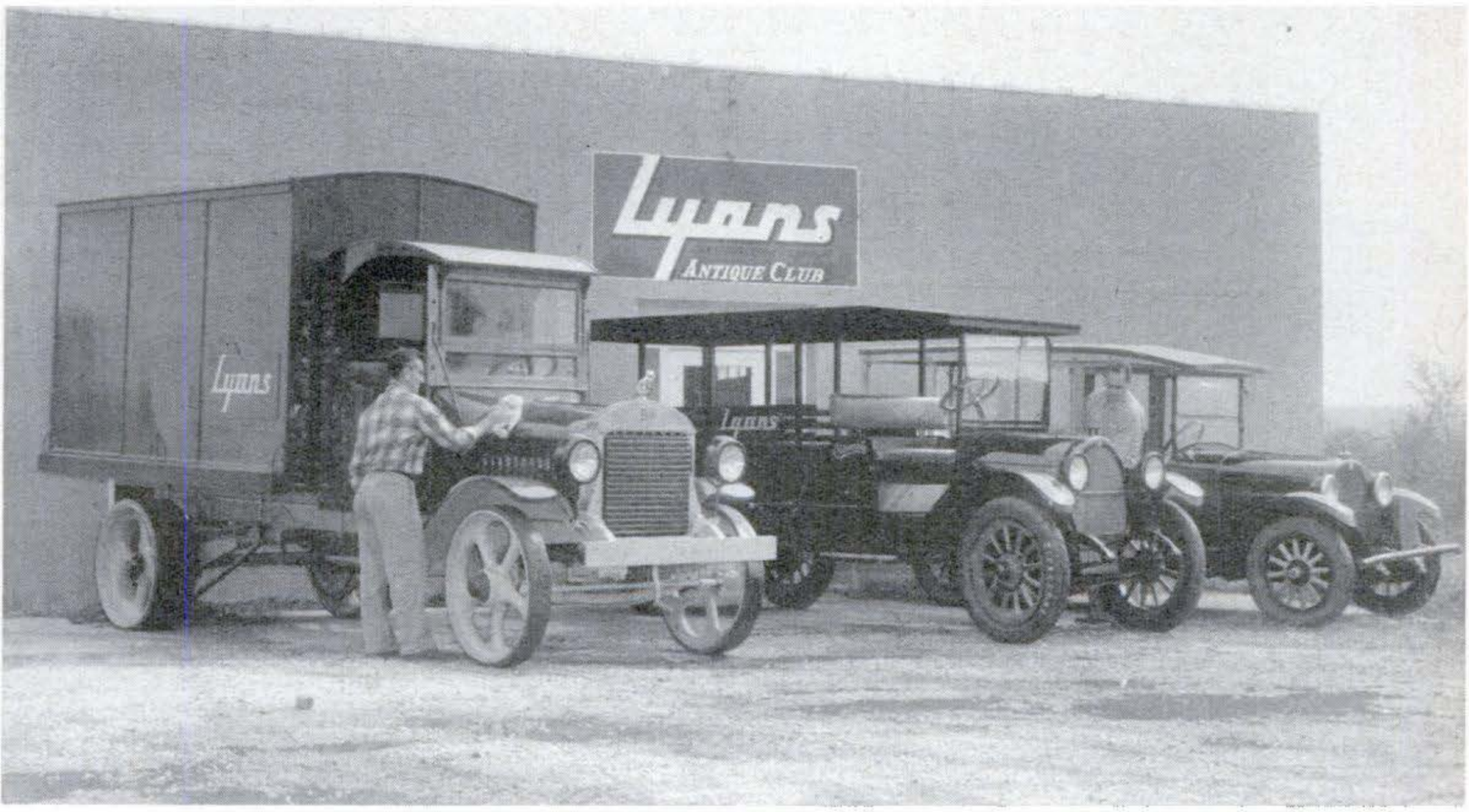
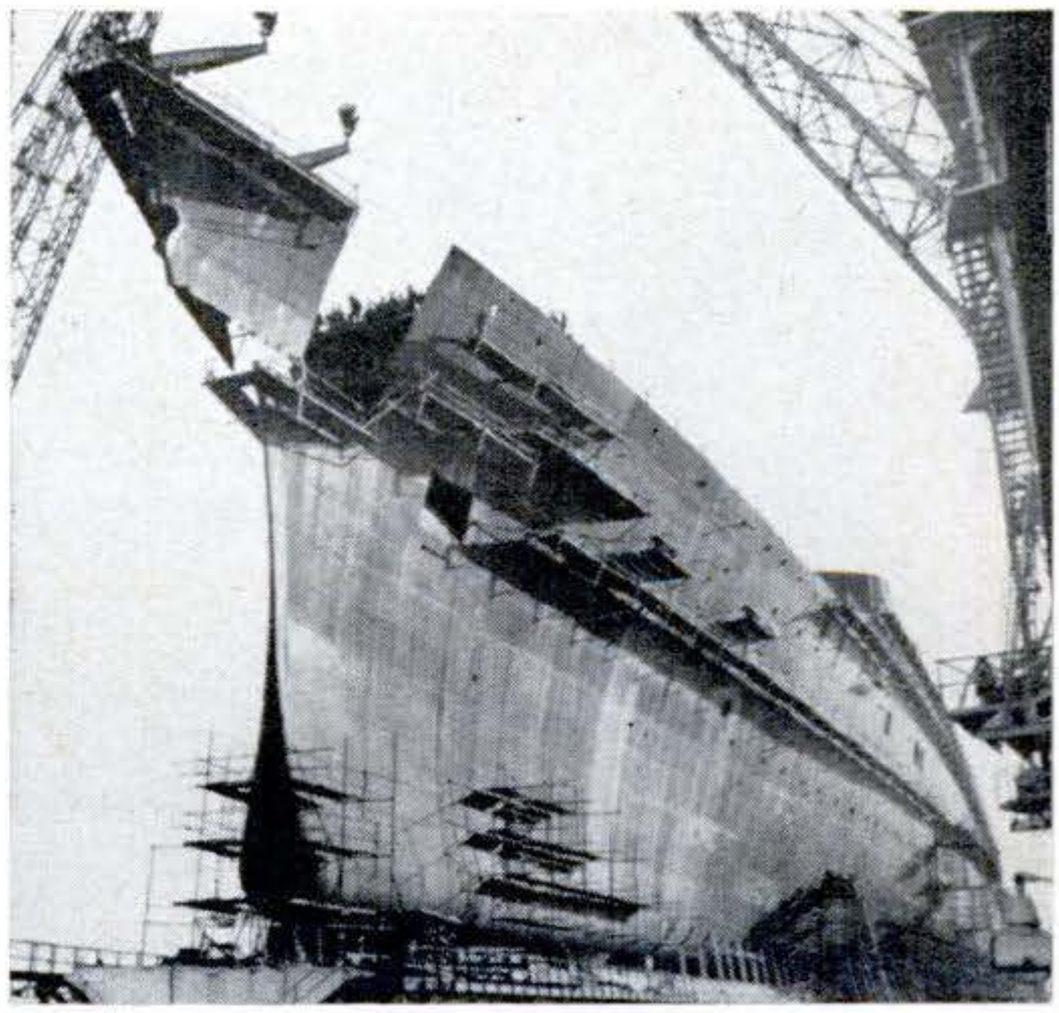
club to make antiques look new



3. Shiny antiques now, a '25 Mack, '17 Oldsmobile, and '27 Dodge are proudly displayed.

Music in the air

Northeast Orient Airlines has installed an organ in a Boeing Stratocruiser on a regular flight between New York, Milwaukee, and Minneapolis. A converter supplies 115-volt current to operate the organ from the plane's 28-volt system.



Big liner gets her nose

The prefabricated stem of the liner France goes into place above at the St. Nazaire yards. The 31-ton piece was hoisted into position by four cranes in 17 minutes. The 1,033-foot, 2,000-passenger ship is to be launched in May.

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Comet: Ford's Not-

Close kin to the Falcon, Ford's "convenient-sized car" is bigger, slicker, more luxurious—but no ball of fire on performance

By Ken Fermoyle

FORD'S new Comet, out of Falcon by Mercury, is a car for in-betweeners who can't decide between a compact and a full-size automobile. The Comet is a little of each.

Mechanically it's first cousin to the compact Ford Falcon. It uses the same engine, similar running gear, and some of the same body parts. But styling, interior trim, and riding qualities smack more of FoMoCo's bigger cars.

Lincoln-Mercury division planners—and the L-M group will build and market the car—don't consider their baby a compact automobile. They call it a "convenient-sized car."

Some comparisons. Comet sedans are 195 inches long and have a 114-inch wheelbase. (Falcon sedans are 181.2 inches long with 109.5-inch wheelbase.) Comet wagons are three inches shorter than sedans, have a 109.5-inch wheelbase, same as the Falcon wagons.

Inside, the Comet tapes out to the same measurements as the Falcon. Head room, leg room, and seat widths are identical. Only bonus is more trunk space.

Both the Comet and Falcon use the same 144-cu.-in., 90-horsepower in-line six. Since the Comet is heavier by 115 lb., (the four-door sedan weighs 2,518 lb. at the curb) its performance and fuel economy aren't quite as good.

So why buy a Comet?

The official theory is that there is a substantial market for a smaller, more economical car, but with more comfort, looks, and luxury than the compacts offer.

And more power may be coming. Ford has already developed a 170-cu.-in. version of the Falcon engine. It delivers about 105 horsepower and should eventually show up in Comets.

(Comet prices still weren't available at press time, but hints were they'd be surprisingly low—meaning not more than $100 or $150 higher than comparable compact-car models.)

The added something. Styling is reckoned as a particularly strong Comet asset.

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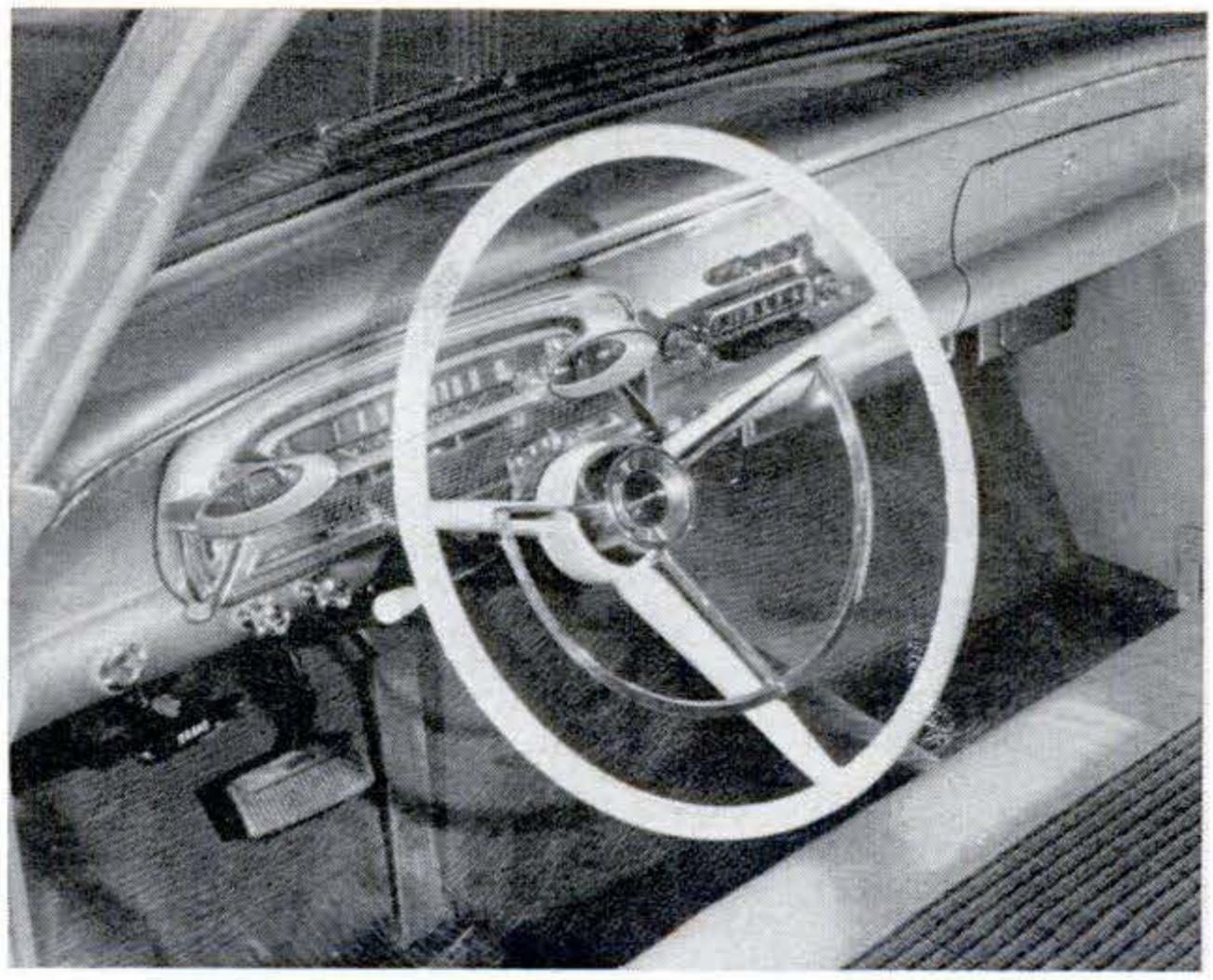

COMET VS. FALCON: Side-by-side, Ford's small cars pose for comparison. Comet (far left) offers big-car comfort and symmetry at a slightly higher price. Above, photo shows Comet's steering wheel and instrument panel.

Quite-So-Compact Car

"The extra length keeps it from having that stubby, chopped-off look of the typical compact," claim its designers. "It has the symmetry of a full-size car without the bulk. We think buyers will like the Thunderbird-like roof line, too."

Comet interiors sparkle with most of the glamor Americans are accustomed to in their bigger cars. Those with the optional trim package (bright window moldings, contour seats, more luxurious upholstery and carpeting) look just like preshrunk Mercurys inside.

Comets come in four body styles—two- and four-door sedans, and two- and four-door station wagons. The deluxe-trim option can be ordered for any model.

Other options include a two-speed automatic transmission, air conditioner, electrically operated tailgate latch for station wagons, and radio and heater.

No power steering or power brakes, though. "The car is light enough so we don't need 'em," is what Comet engineers have to say about this.

Stretching wheelbase to improve ride is an old dodge—and it worked again in the Comet. A trip over some back roads

Longer, heavier Comet rides smoother than Falcon. But, with same engine, it's less lively.

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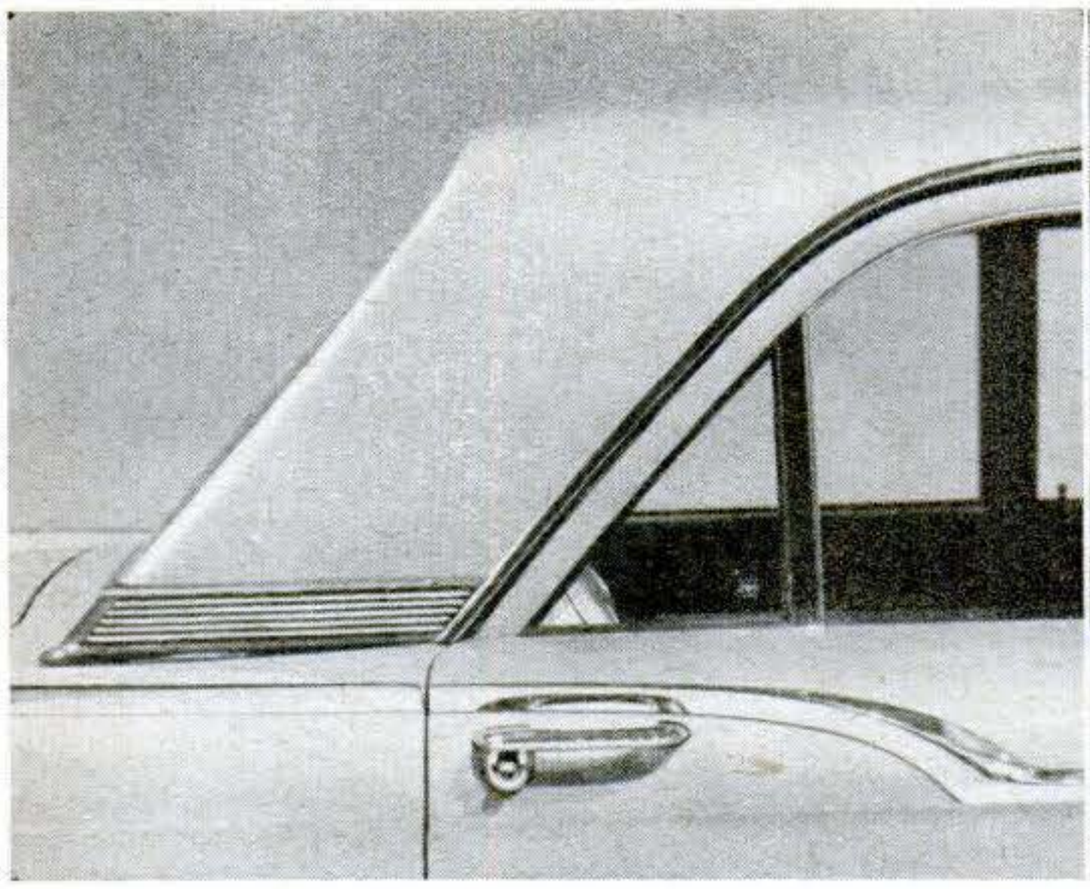
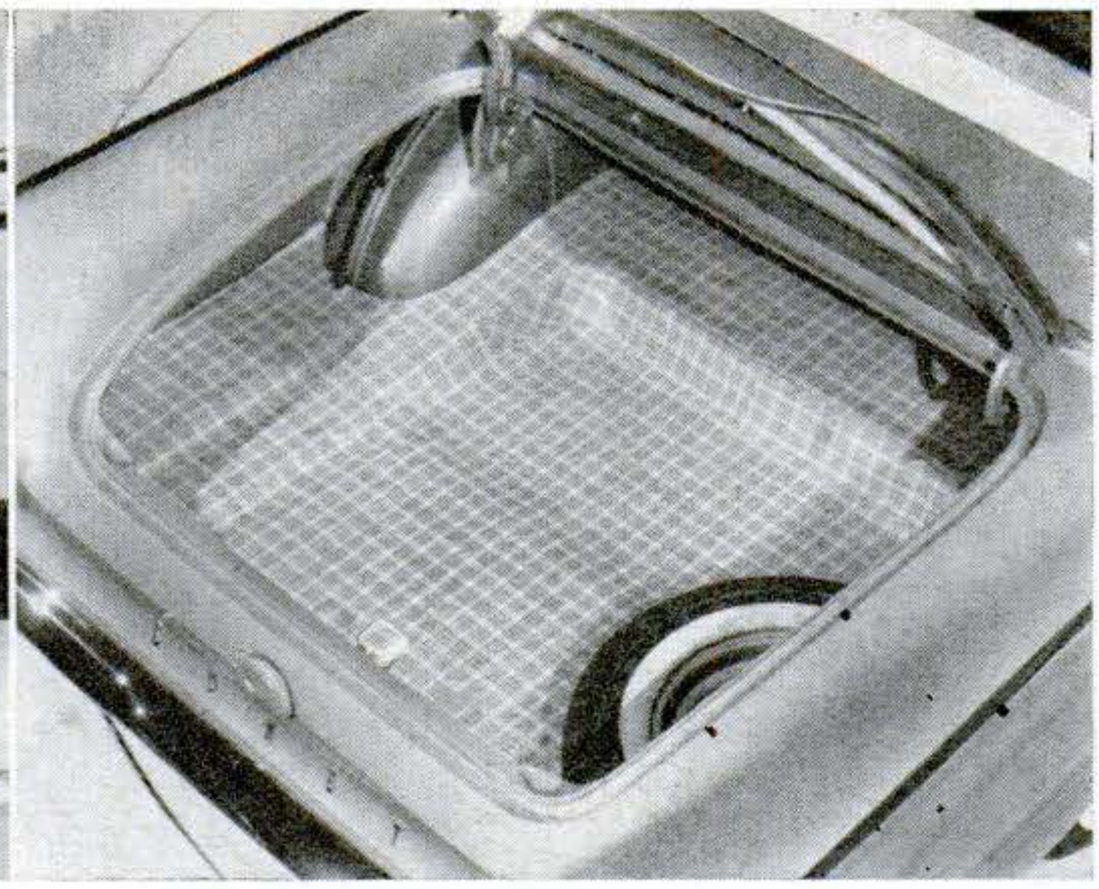


THUNDERBIRD STYLING shows itself to informed observers in smart lines of the Comet's rear quarters. Note the flattened T-Bird roof.



INSIDE MEASUREMENTS of Comet are same as Falcon's except for bigger trunk compartment. Comet's measures 26.6 cubic feet; Falcon's 24.5.

on Ford's desert proving grounds near Kingman, Ariz., proved that.

The extra 4.5 inches of wheelbase gives sedans a better ride, with less fore-and-aft pitching, than the Falcon. Suspension refinements, such as bigger rubber bushings in rear spring eyes, contribute to a smoother ride in either sedan or station wagon.

The margin of superiority is slight, however. Unless you jump directly from a compact to a Comet, run over the same course, and pay close attention, you might not notice the difference.

What to watch for. Comet handling is just so-so. It is more agile than a full-size Detroiter, but not as nimble as the compacts. It rolls enough in tight turns to toss passengers around a bit.

You don't power this car through corners—the power isn't there. The little six-cylinder engine is willing and sings happily even at rather high cruising speeds, but it doesn't have the muscle to make the Comet an exciting car to drive.

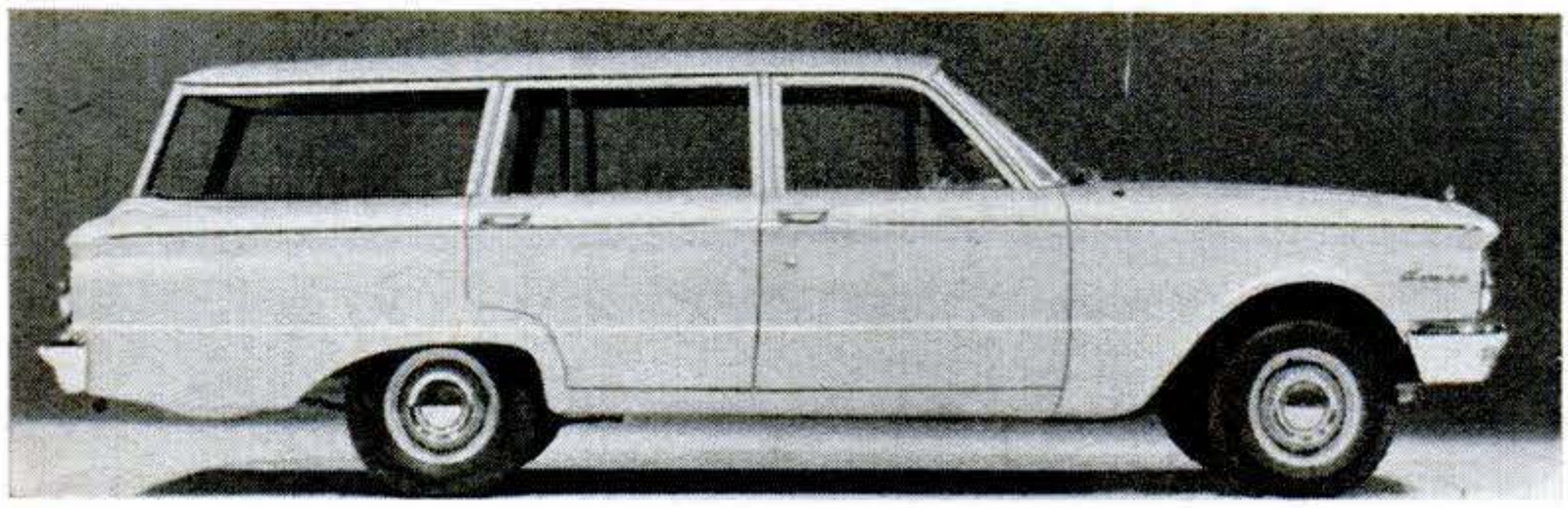
Acceleration is, to be charitable, leisurely. Getting from a standstill to 60 m.p.h. takes almost 25 seconds. Mid-range passing takes time: about 12 seconds from 40 to 60 m.p.h. Drivers used to bigger, more powerful cars will have to look for longer stretches of clear road to pass safely.

How fast will it go? The top speed of nearly 90 m.p.h. is more than enough for all normal needs. And the Comet wings along comfortably at 70 m.p.h. with no signs of distress.

Fuel economy is good. Not quite as good as the Falcon's, but considerably better than with the big Fords. Highway cruising at 50 to 60 m.p.h. should net 25 m.p.g or better. Around town, the average is about 20 m.p.g.

All cars are compromises—but the Comet is more than most. And Lincoln-Mercury people admit it—even with some pride. They think they've got the right kind of compromise to appeal to a lot of buyers who are fed up with big cars, big prices, and big operating expenses—but don't want to step down to the short-wheelbase compact cars.

"Our Comet is the logical way station for them," says L-M. It will be interesting to see how many get off there.



COMET WAGONS come in two- and four-door models, with lots of options that can make them look and feel like preshrunk Mercurys inside. Suspension refinements, such as bigger bushings in the rear leaf springs, smooth the Comet's ride.

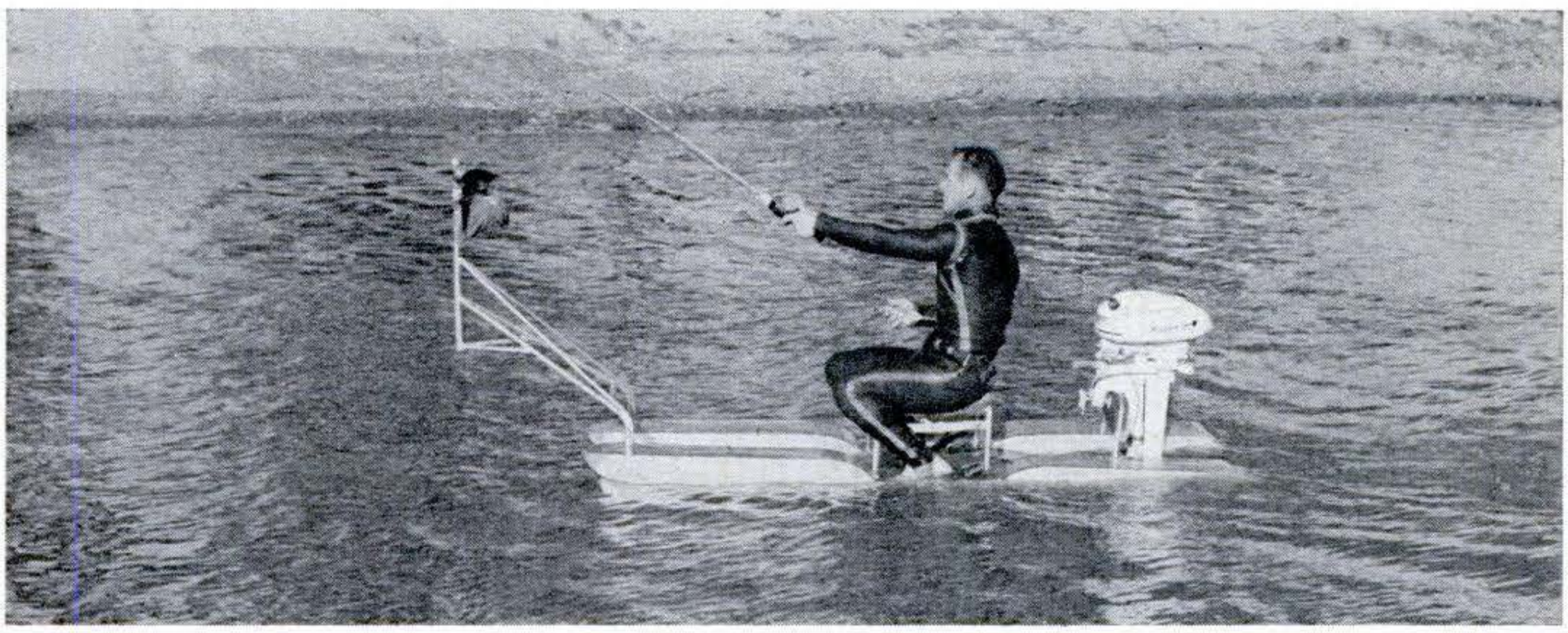
Copyrighted material

Recessed panel phone

The telephone above can be recessed in a kitchen wall or cabinet. It is being tested with Bell subscribers. Experimental models have chrome or copper face plates, and separately mounted handsets and dials in color. The cord retracts.

High-level station

When engineers laid out the railroad along the Rhine, there was room at Kammereck for only the tracks between a cliff and the river. They built the station at second-story level to allow trains to pass. It's reached by stairs.

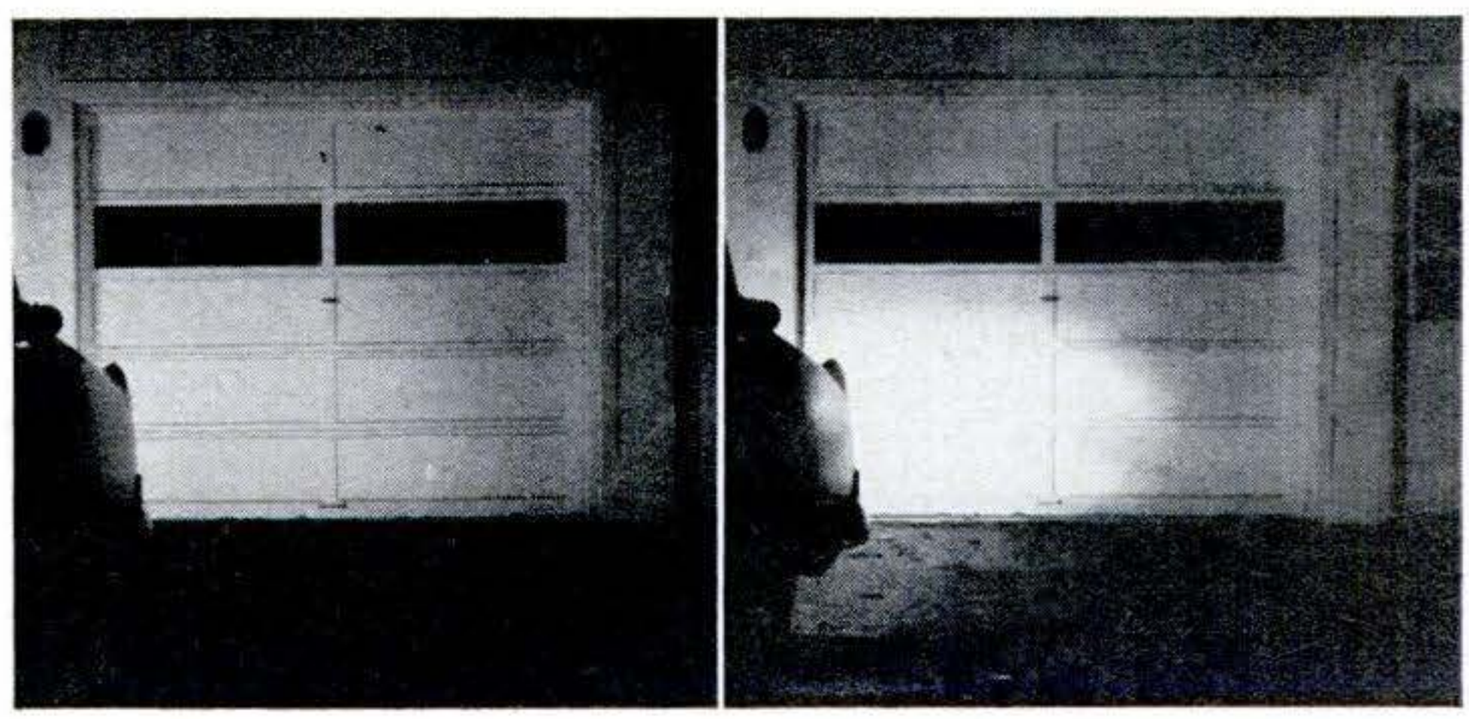


He walks or rides

Damien Fournier, a Canadian inventor, designed water shoes that he can strap to his feet or lock together for use as a boat. They are built of aluminum, are held rigid by a special seat, and are buoyant enough to support an outboard.

Back-up light

A sealed-beam back-up lamp contains in its housing a non-tarnish aluminized reflector that helps it throw light in a 50-degree arc as far as 30 feet behind a car. It is designed like a miniature headlight. The new Westinghouse lamp and an old model are shown in use at right.



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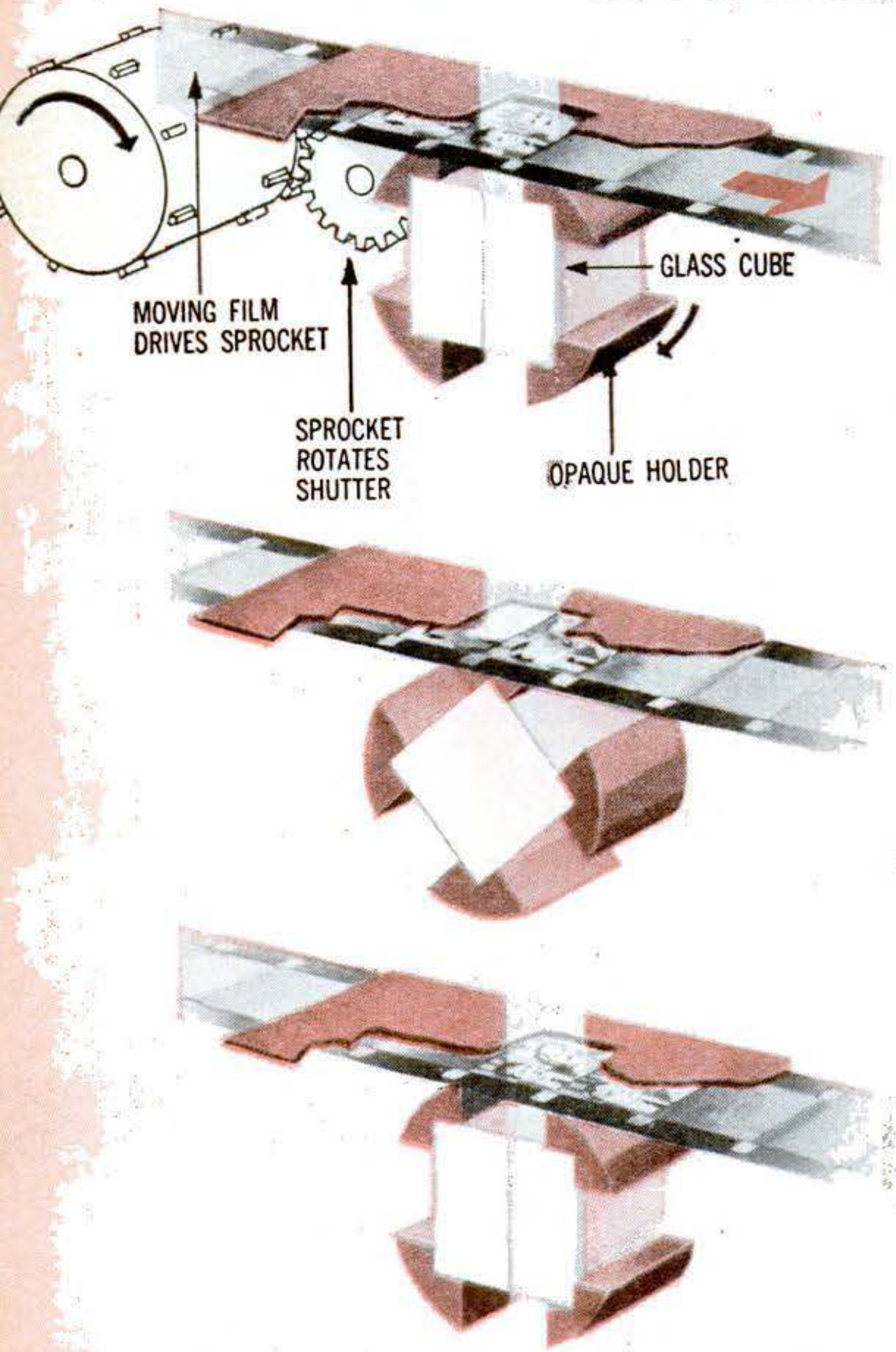
How a Home-Movie

How it changes still pictures to movies



THE SHUTTER, a rotating prism, opens when the middle of each frame is centered in the light beam. It closes as the lines between frames pass through the beam. Thus, only the picture part of each frame appears on the ground glass. The lines are blocked out, causing an interval of darkness between pictures. If the film moves fast enough, the eye blends the sequence of still pictures together. This gives roughly the same impression of continuous motion as a movie projector. Shutter and film speed are synchronized automatically. As the film moves through the viewer, it turns a sprocket to rotate the shutter. The shutter makes a quarter-turn as the film advances one frame.

How movies are projected onto the viewing screen

LIGHT from the projection lamp shines through a square hole in its metal shield and strikes a tiny angled mirror. Bent downward through a lens, the beam is focused on a frame-sized section of film. This projects an image through a hole in the viewer, through the shutter, and onto a small angled mirror below. From here the image is reflected onto a larger, vertical mirror and then onto a still larger angled one. The image, enlarged in its travels, now fills the ground-glass screen when reflected upward by the last mirror.

HOME movies started modestly in 1922 when the first portable movie camera for amateurs came on the market. It was spring-wound and used 16-mm. film. Not until 1936 did eight-mm. cameras appear, converting a rich man's hobby into an industry. Since World War II sales of home-movie equipment have soared.

Today, amateurs own some half-million 16-mm. cameras, five million eight-mm. cameras. About 80 percent of the film used is eight mm.

What do home-movie makers film? A trade-association survey disclosed that family pictures are by far the most popular. Next, in order, are vacation shots, children, babies, and, a poor fifth, pets and other animals.

One of the first accessories a serious amateur film producer adds to his equipment is an editor. With it he can project his films slowly, snip out some parts, add others. The outfit described here is a Craig Projecto-Editor for 16-mm. film, made by the Kalart Co.

Copyrighted material

Editor Works

RIGHT-ANGLE PRISM

75-WATT PROJECTION LAMP

GROUND GLASS

MIRROR

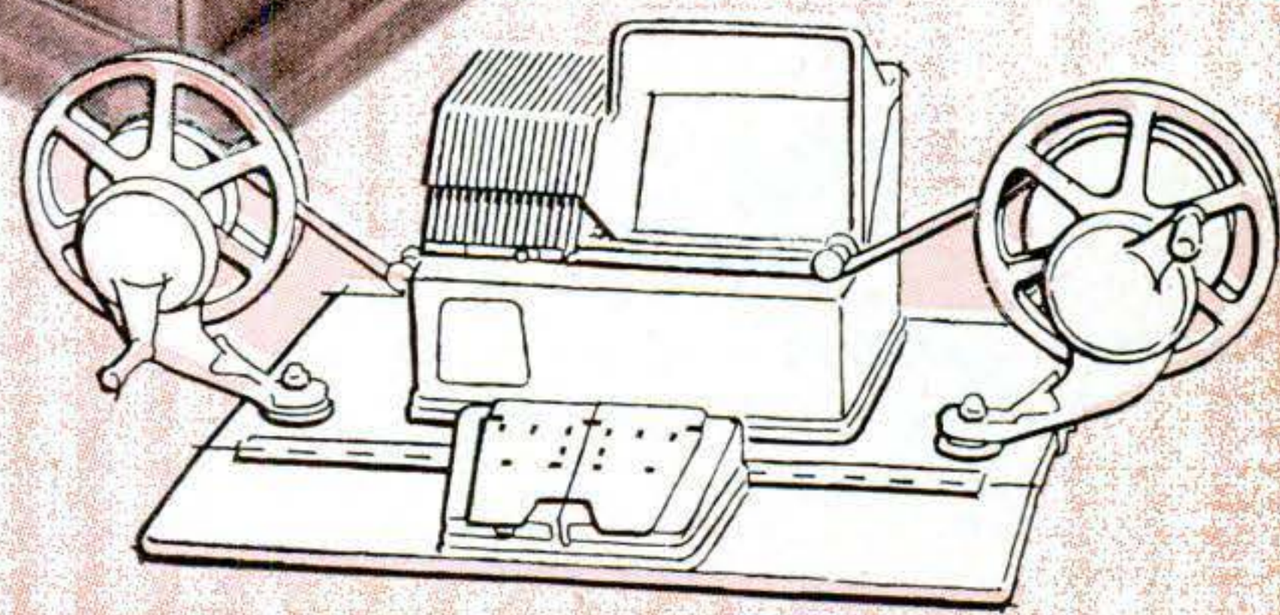
SHUTTER

MIRRORS

FILM-GUIDE WHEEL

An editor includes rewinds, viewer, splicer

FILM TO BE EDITED is pulled through the viewer by cranking the right-hand rewind. When the projected image indicates that a clip of film should be removed or added, the length of film in viewer is lifted out and clamped in the splicer. The splicer cuts the film, and also aligns and holds the cement-coated ends together.



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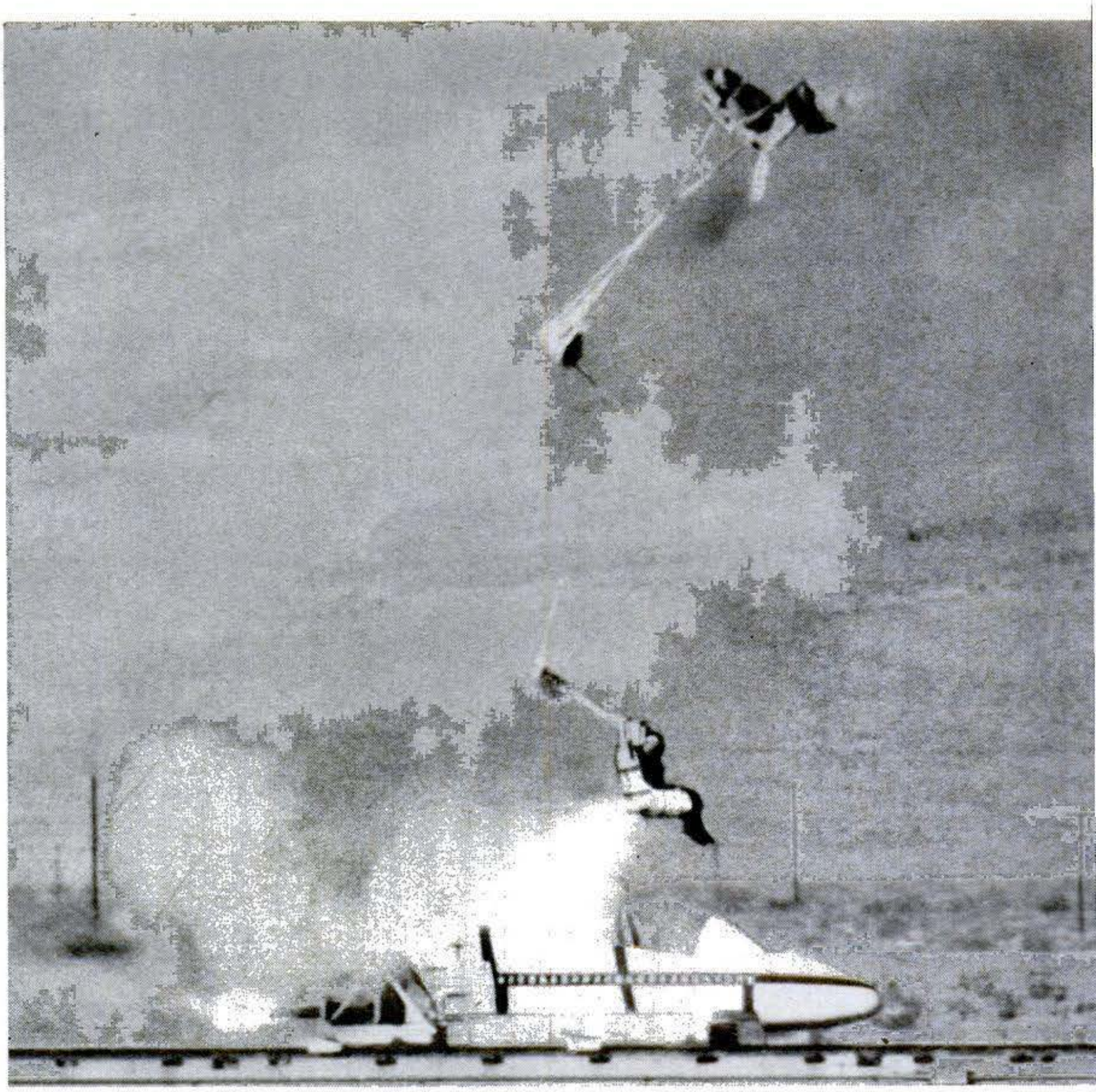
Front man goes last in rocket blast

The man in the rear gets away fast in this new tandem rocket-ejection seat now being used on the Navy's two-place T2J Buckeye jet training planes.

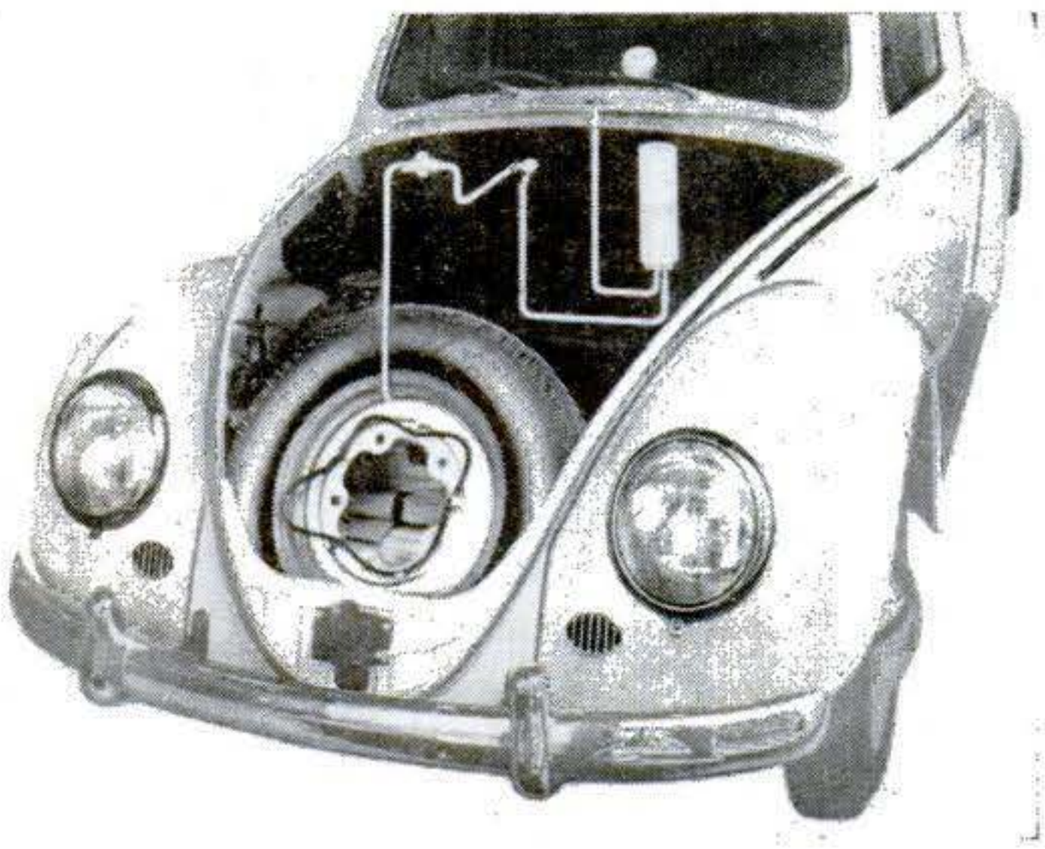
This gets him out of the way and safely into the air before the forward rocket blasts, and protects him from being struck by the forward seat.

The device can be triggered by a senior pilot from either front or back. In either case, the rear seat goes first, the front follows .4 second later.

If one man is disabled, the other can control the system.



Rear dummy leaves sled first to avoid blast from forward seat.



Tire washes windshield

Air from the front-mounted spare tire powers a new British windshield washer. Pushbutton operation from the dash needs no pump. After two emptyings of the water bottle, the tire is reinflated by means of a valve on the upright partition.

Unintended roof garden

Vines from seed planted beside Mrs. Marcella Olivan's garage in San Pedro, Cal., took off for the wild blue yonder and wound up with a crop of giant squash on the roof. A neighbor helping her harvest holds aloft a 50-pound specimen.

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Seat chutes open as seats and riders separate. Then dummies' own chutes open for landing.

Portrait television

Closed-circuit TV is used by David Ugent, Miami photographer, to give customers portrait previews. The TV camera is mounted beside the portrait camera and hooked up to a monitor. The sitter picks the pose before the picture is taken.

Portable dental machine

This drill can be carried to a patient on a farm or other far-off area. Invented by a San Diego, Cal., dentist, it does all the work of an office machine. The shaft is turned by carbon-dioxide gas. It handles 125 patients without refueling.

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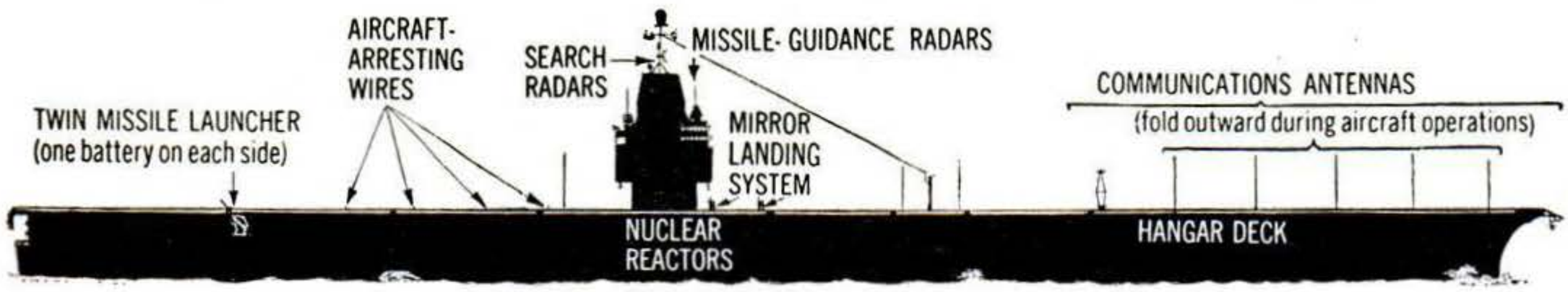
U.S. Atomic Carrier: World's Biggest Ship



Length: 1,100 ft. Max. width: 252 ft. Max. speed: 35 knots. Crew: 4,000 officers and men.

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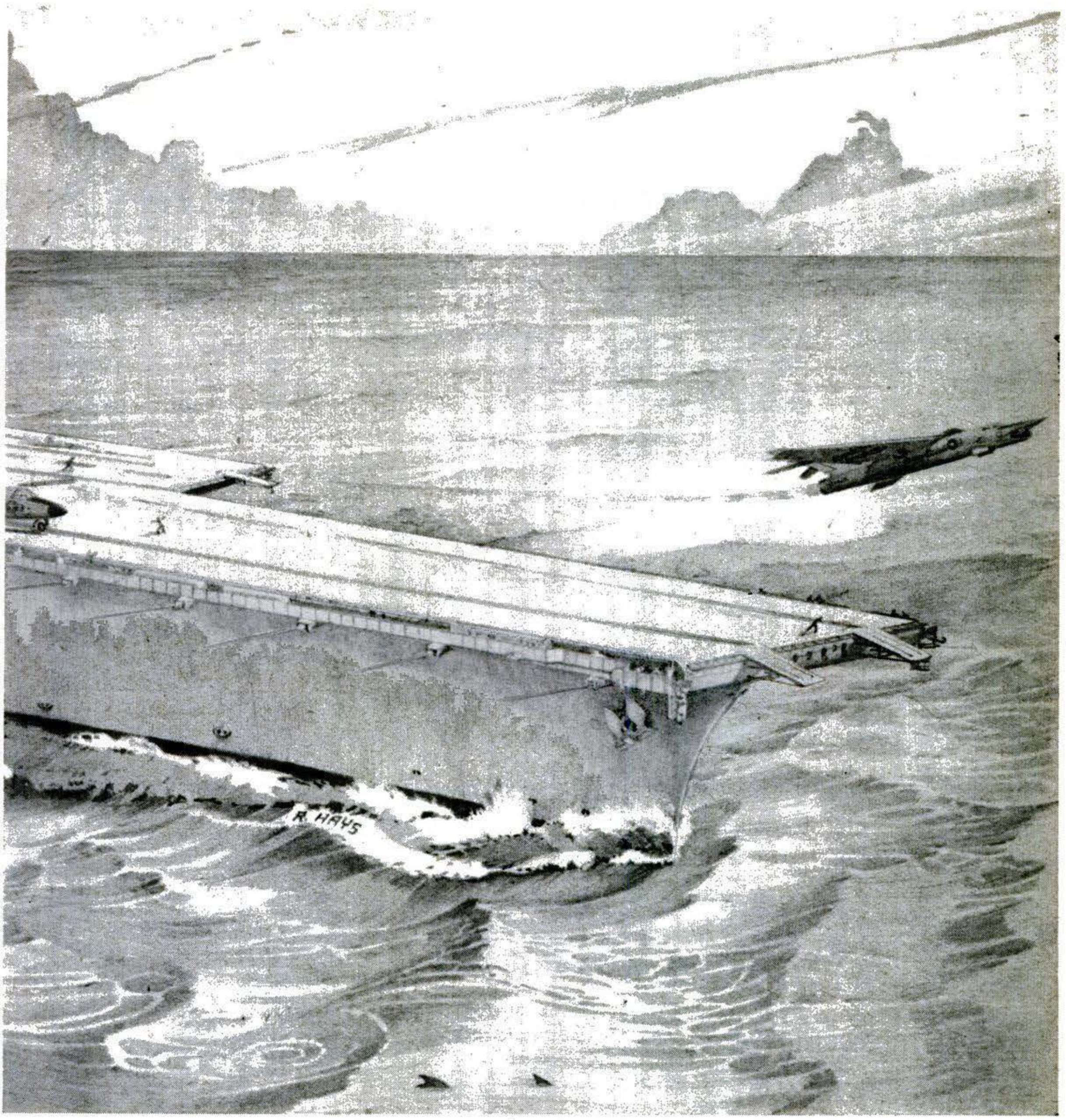

WHEN the 85,000-ton USS Enterprise is launched at Newport News, Va., this summer, she will be not only the world's first atomic aircraft carrier but the biggest ship afloat.

With a flight deck 4,000 square feet larger than the Forrestal class, and greater hangar space, there will be room for more than 70 aircraft, from fighters to the Navy's biggest jet bombers. Launching catapults will be powered by steam from the atomic reactors. For defense, the carrier will be able to launch surface-to-air guided missiles from each side aft.

Eight nuclear reactors, two for each of four propellers, will enable the Enterprise to steam at a top speed of about 35 knots for indefinite periods—and to operate at sea for five years without atomic refueling. In terms of a conventional carrier, this represents 175,000,000 gallons of fuel oil. And not needing oil for her own propulsion, the new seagoing airbase will be able to store twice as much aviation fuel for her aircraft.

Cost: $435,000,000.

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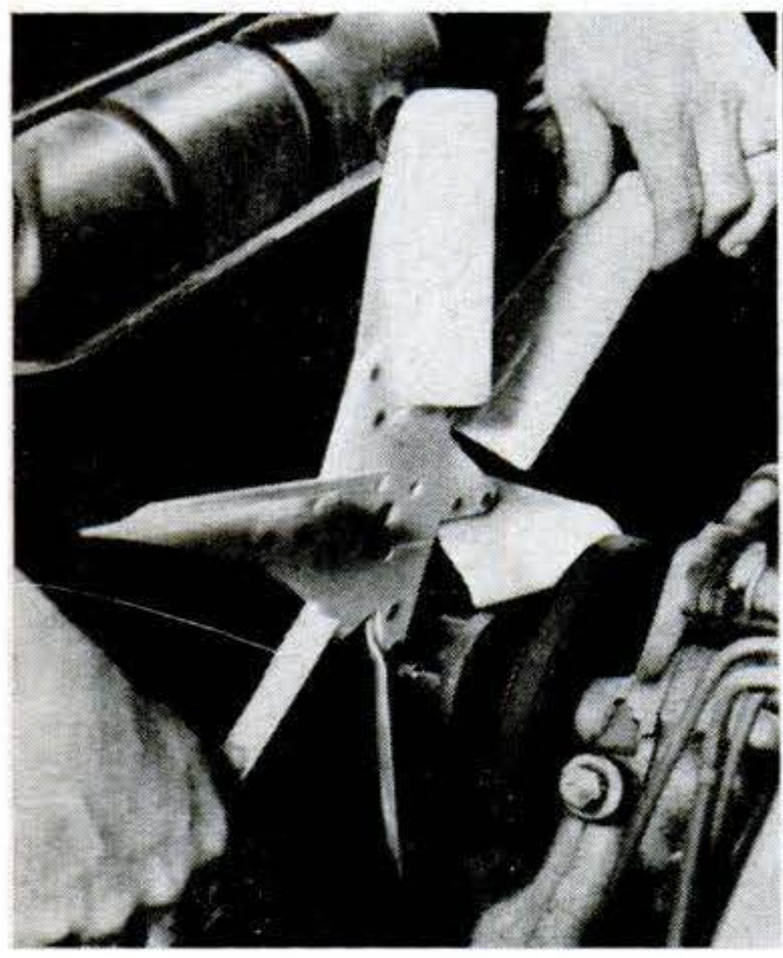
Power Winch Easy to Carry

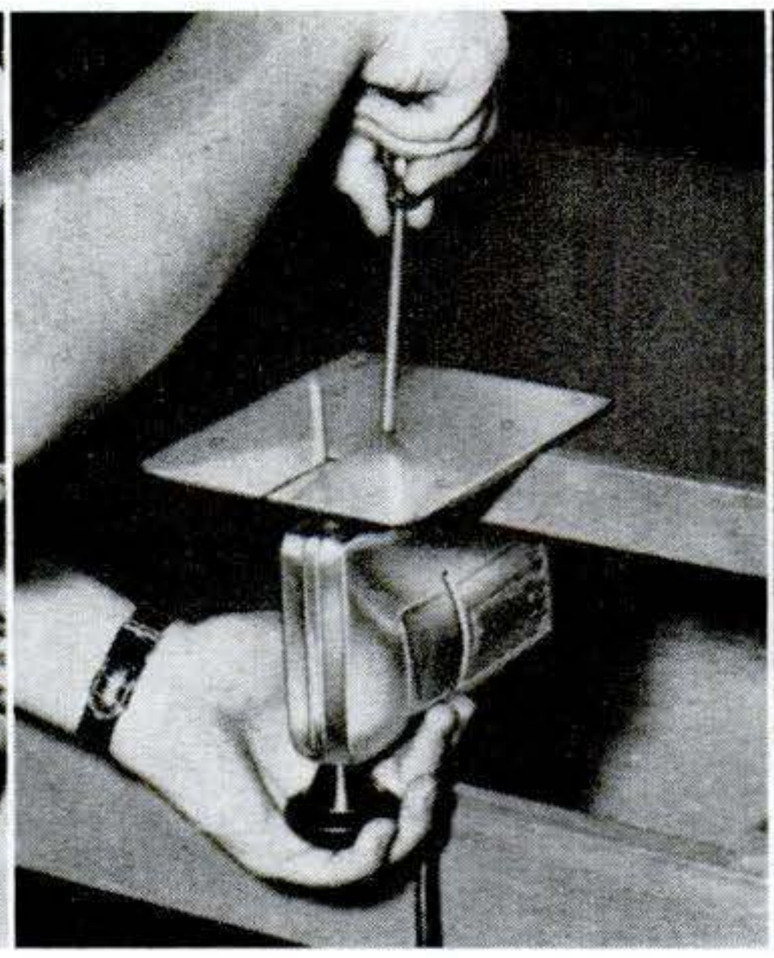
This portable power winch weighs only 75 pounds and is about twice the size of an ordinary typewriter. Yet it will uproot a big tree stump, heft a boulder, or operate a boat hoist. A geared-down four-cycle gas engine drives it.

Transported to the work site, the power winch is anchored to a fixed object or to a stake driven into the ground.

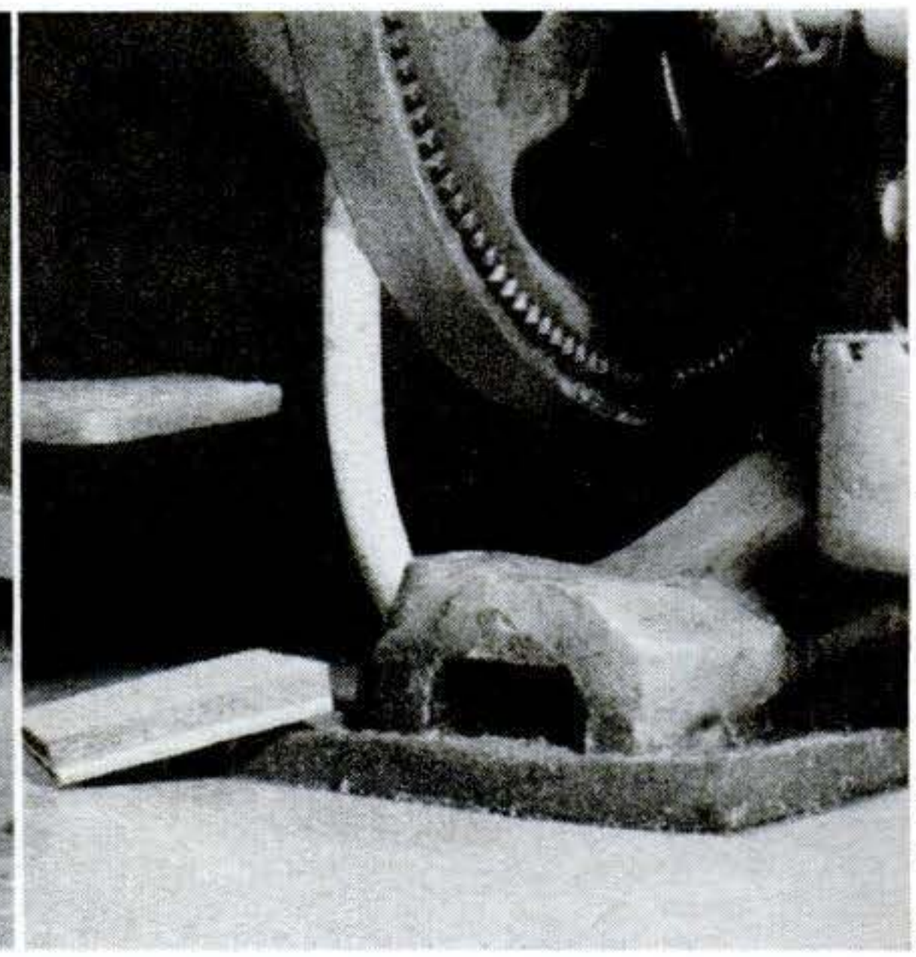
It sells for $279.95. Easy Go Products, Inc., Box 37, Kenmore, Wash.



FIBER-GLASS FAN, a fourth the weight of a steel one, takes less power to turn, has less inertia, and is said to improve gas mileage. It has six translucent blades. Different mounting holes fit a variety of cars. Sun-Glas Mfg. Co., Mt. Sterling, Ill.



JIGSAW TABLE converts a portable electric saber saw for bench work. It's a grooved and notched plate that you screw to the bench. The saw is bolted to it. Jigsaw and table complete, $29.50. SpeedWay Div.-Thor, 1421 Barnsdale Rd., LaGrange Park, Ill.



VIBRATION PADS of felt go under machine feet to suppress noise, eliminate mounting bolts. A home-workshop kit contains four four-inch pads and a pint of adhesive, $5. Mike Krasilousky Trucking & Millwright Co., 426 Lafayette Ave., Brooklyn, N.Y.

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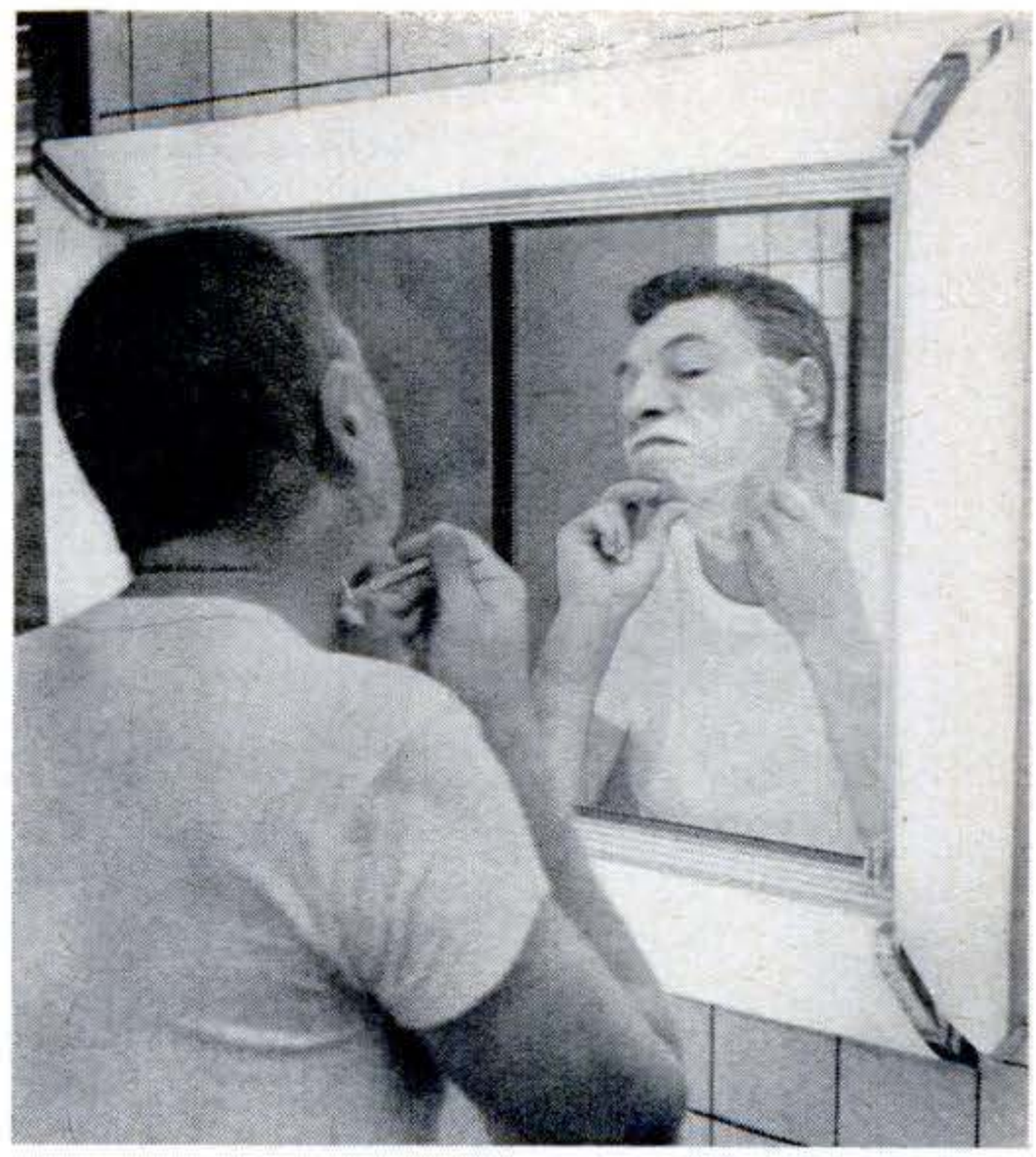
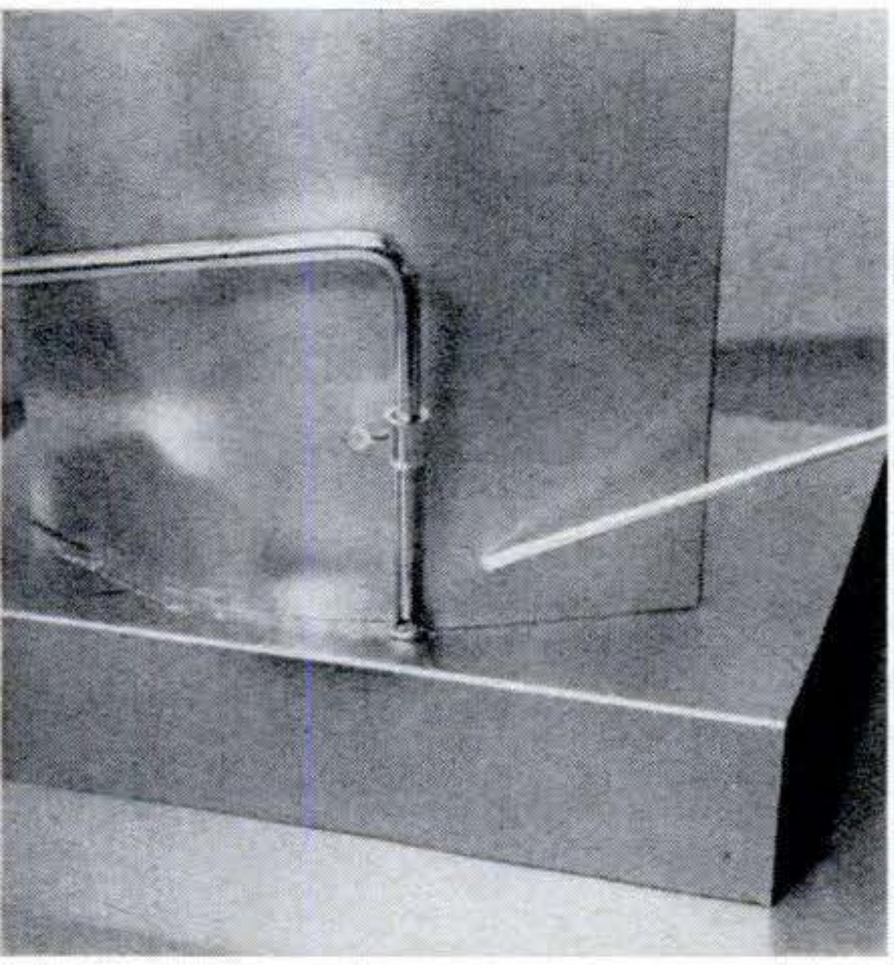
SOUND-DAMPING FELT takes the booming sound out of the bass notes of a hi-fi. It comes as a pad and is easy to install inside the cabinet where, according to a recent engineering report, it proves more effective than cellulose fiber or fiberglass. A one-square-yard package costs $5.98. Continental Felt Co., 22 W. 15th St., NYC.



PERIMETER LIGHTING on a new medicine-cabinet door lets you see every whisker when you shave. You light either the side fluorescents, top and bottom, or all four. The metal cabinets come with one hinged or two sliding mirrors. The plastic shades are easy to remove when replacing tubes. National Steel Cabinet Co., 2415 N. Pulaski Rd., Chicago.



SOLDERING TOOL simplifies soldering of aluminum. You melt solder with a torch, rub it into the joint with a bent fiberglass brush that removes oxide. Kit contains tool, two brushes, and solder stick, $1.98. Reynolds Metals Co., Richmond, Va.

WOOD FILLER you get in the form of a pencil is rubbed in to hide nail holes and small cracks in paneling, furniture, or other woodwork. It is said not to shrink, loosen, or stain, and comes in 12 blending shades. Magic Iron Cement Co., Cleveland.

SATEL-LITE LENS has two red and two chrome bullets on a translucent red-lucite background. It replaces standard Ford and Thunderbird tail-light lenses, screwing into their mounting holes. California Custom Accessories, 1807 W. 65th St., Los Angeles.

CONTINUED

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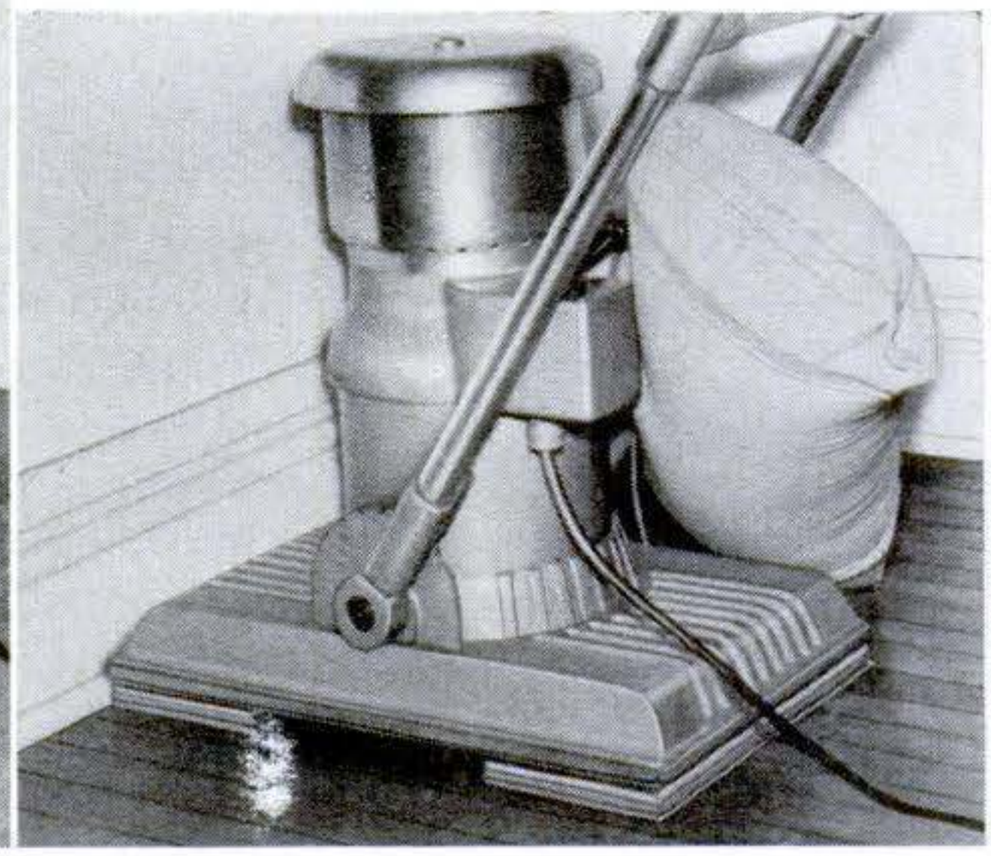
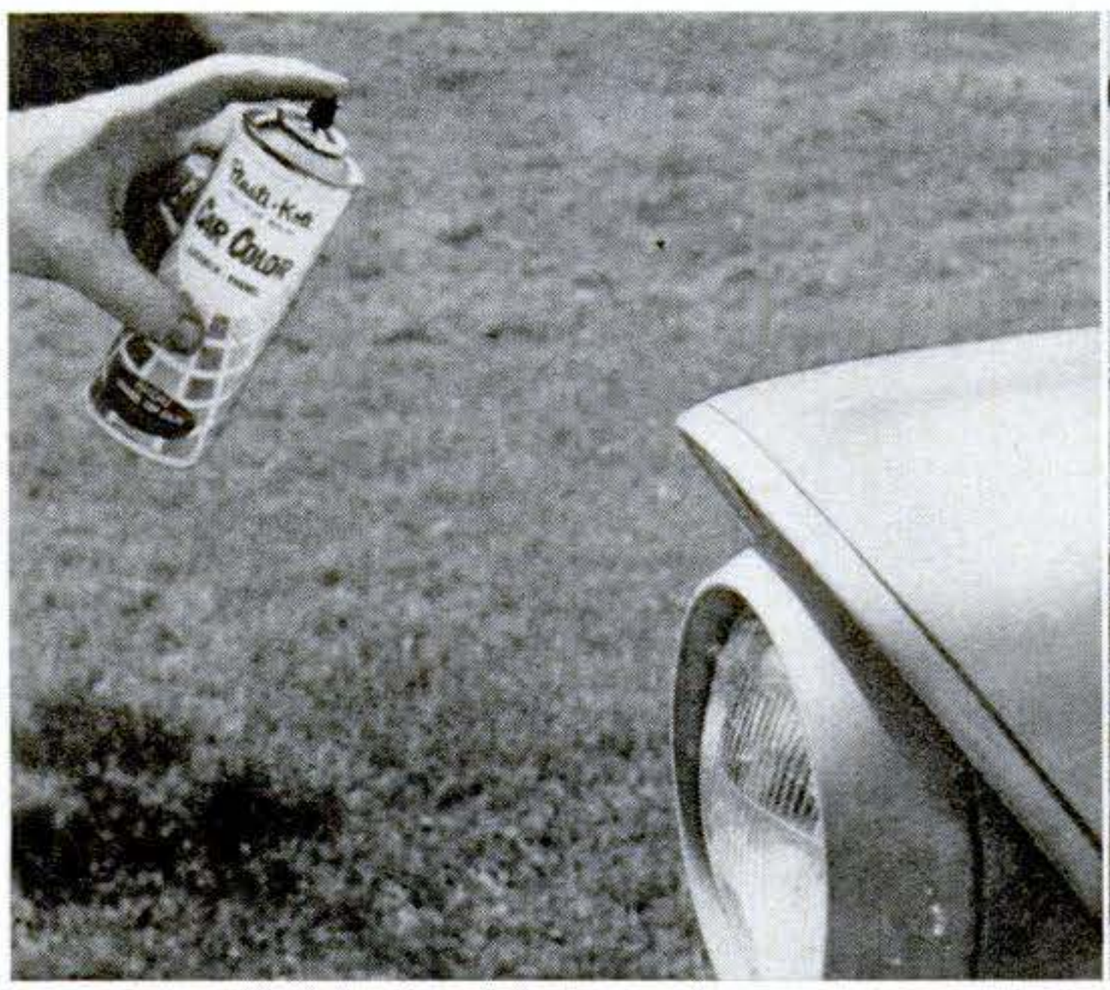
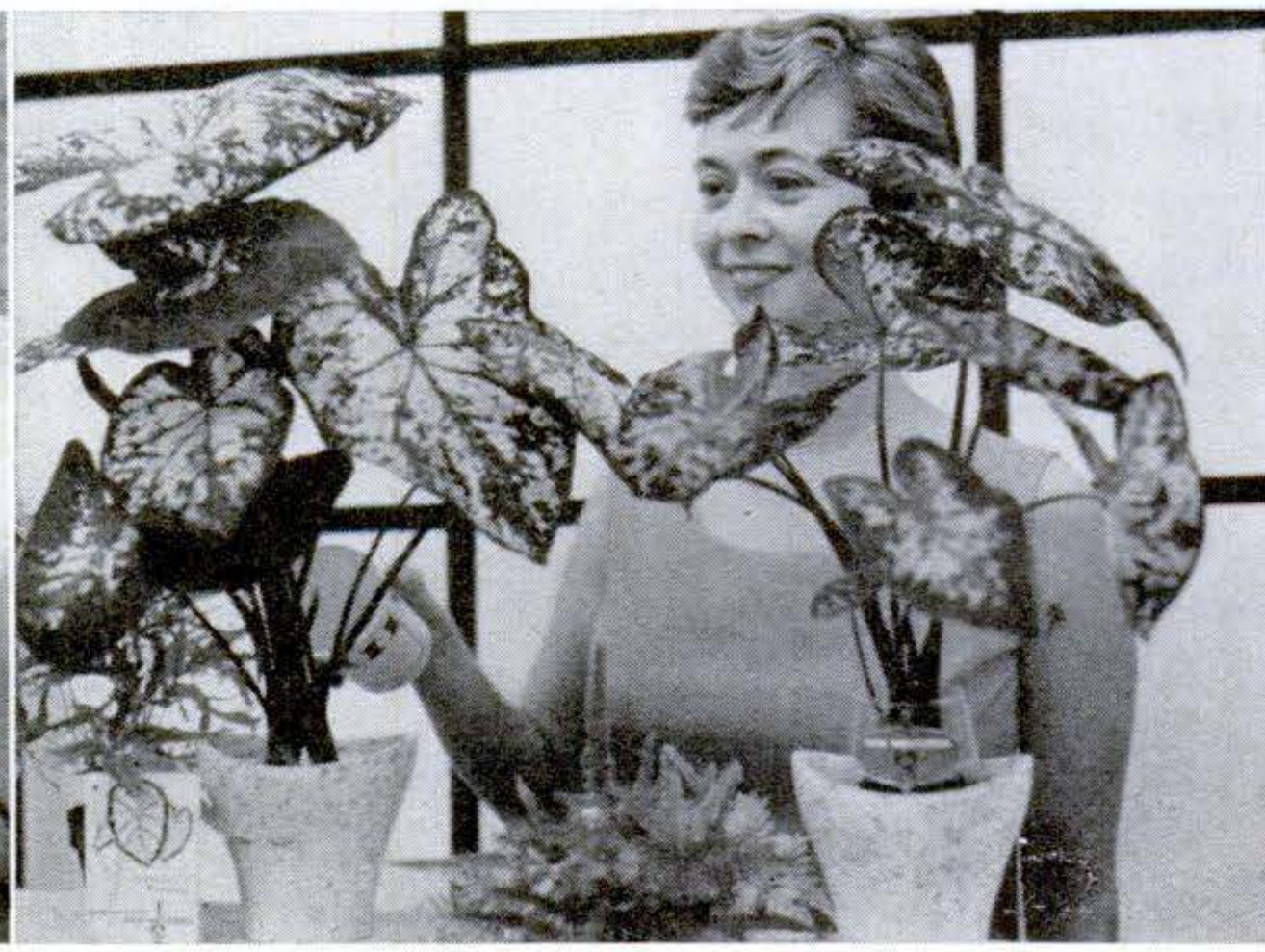
Vacuums Floor While It Sands

This floor-finishing machine cleans up debris as it works. It has twin sanding pads at front and back, won't gouge, and sands flush with baseboard and in corners. It is manufactured for rental service in most major cities. Statler-Petoskey Corp., 20356 Grand River Ave., Detroit.





AEROSOL SPRAY PAINTS to cover dents, nicks, and scratches are made in 300 shades to match the original paint of late-model Fords, Plymouths, and Chevrolets. The caps of Car Color cans match the contents and are identified with the year and model they duplicate. Eight-ounce can, $1.69. Plasti-Kote, Inc., 9801 Harvard Ave., Cleveland.



PLASTIC-POTTED BULBS are imported from Holland and sold through supermarkets, variety and chain stores. They include amaryllis, caladiums, and paperwhites, and are replaced if they fail to grow within a few weeks after water is added to the plastic planter. With planter they sell for $1.49. M. van Waveren & Sons, Inc., Little Falls, N. J.

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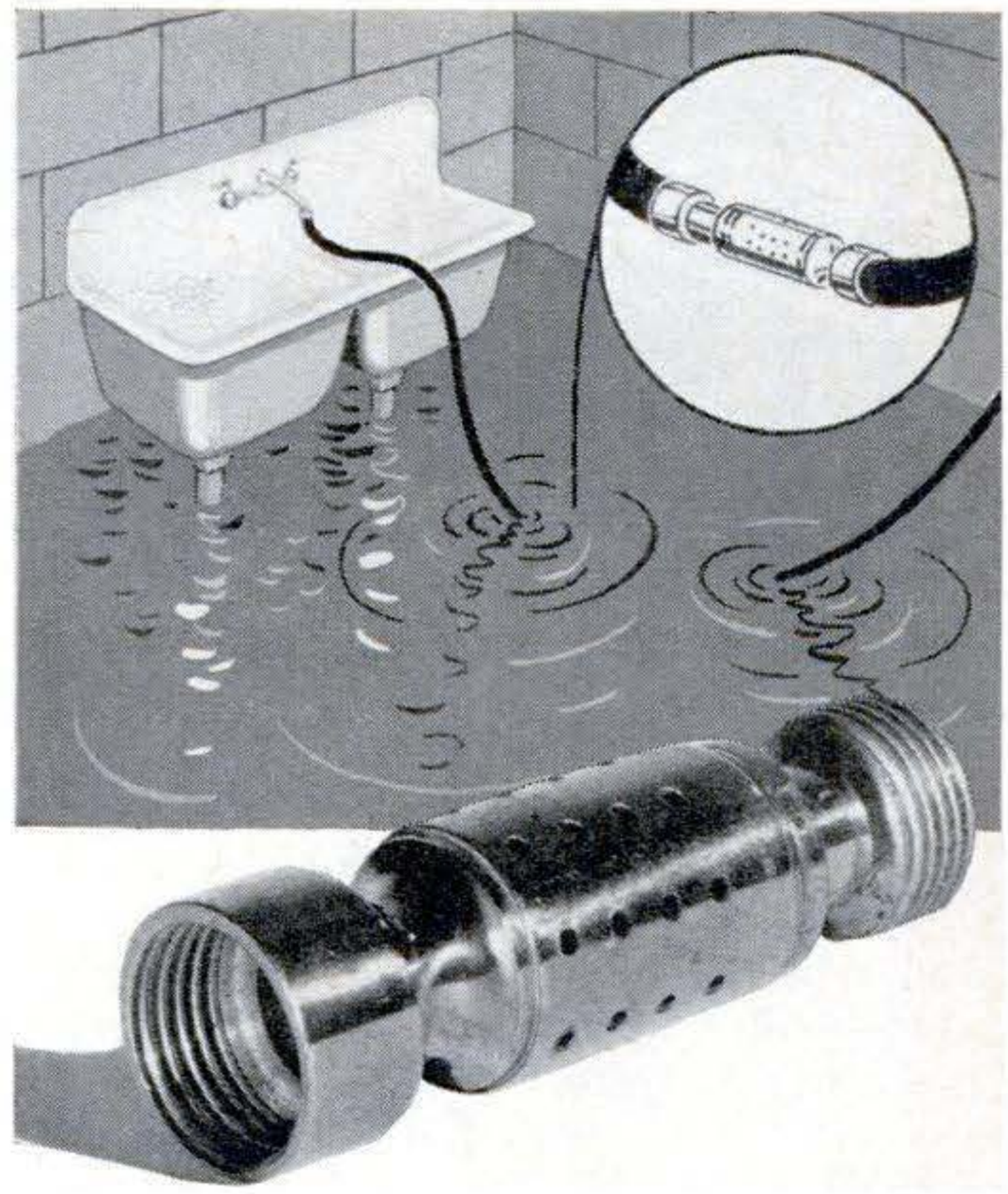
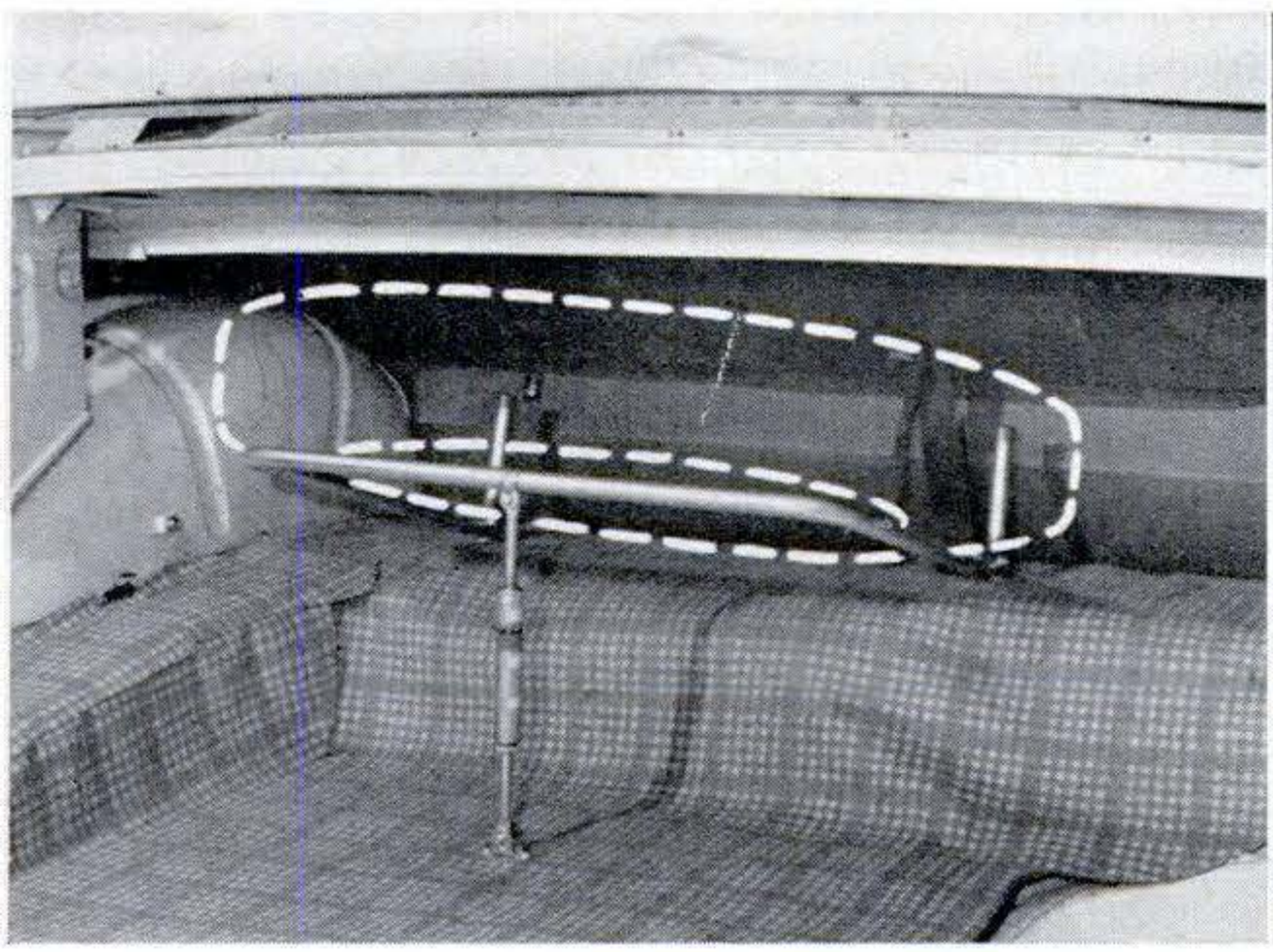
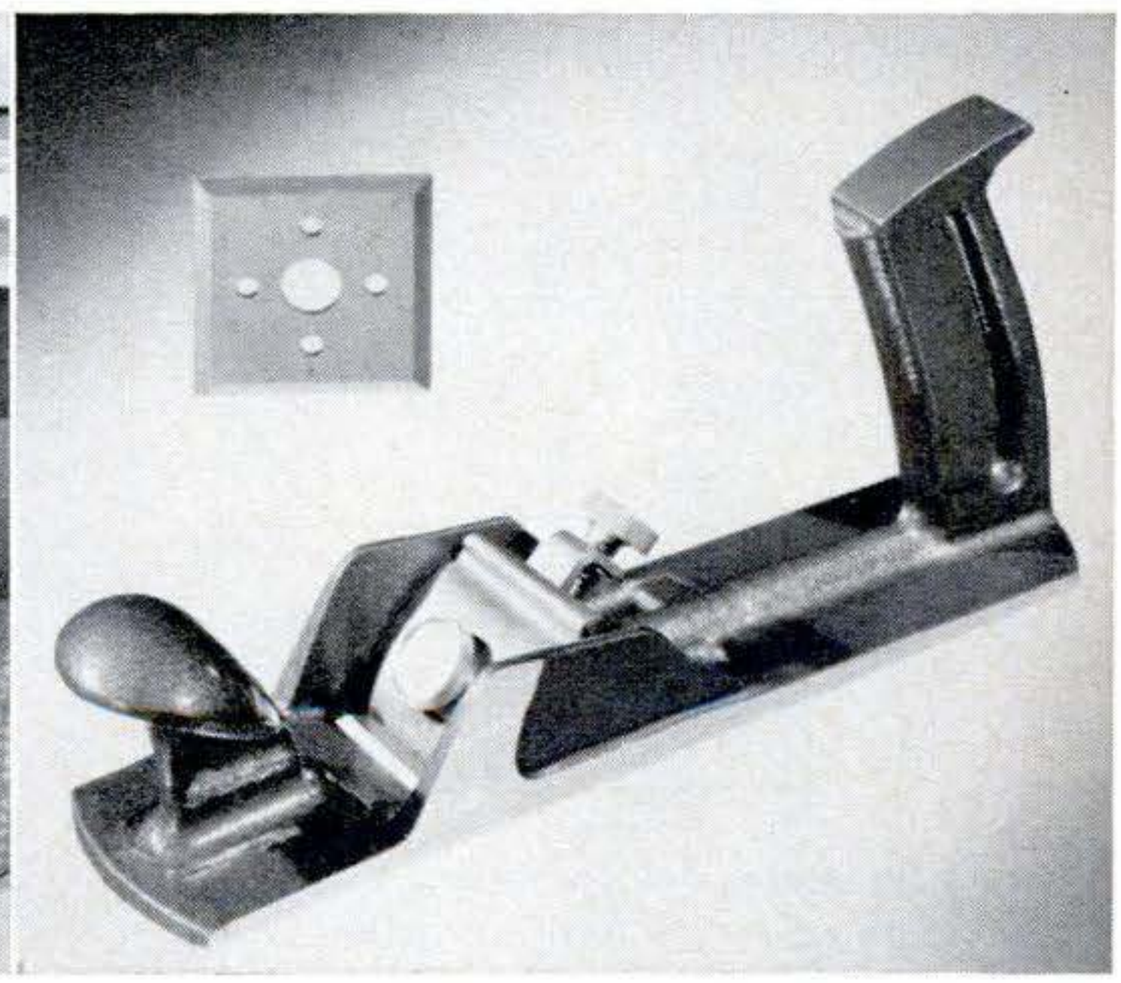
RECHARGEABLE FLASHLIGHT has two 1.2-volt cells, throws a 200-foot beam, is recharged by plugging into any 110-volt outlet. It's equipped with a luminescent switch that enables you to find it in the dark, a magnet that holds it to a car body, and a leather carrying thong. $9.95. Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.



DRAIN PUMP is an arrangement of two cylinders, one inside the other, that acts as a venturi tube when attached to a garden hose. It creates a vacuum to suck water from a basement or back-yard pool. It is said to pump five gallons a minute, or 300 an hour. With short hose, $3.77; without hose, $2.77. Mrs. Dorothy Damar, 769 Damar Bldg., Elizabeth, N. J.



TIRE RACK relocates the commonly side-mounted spare forward in the trunk, leaving room over the tire well for additional luggage. The rack is held by an adjustable turnbuckle arm screwed to the floor. In correct position, the tire can be slid out without removing luggage from the trunk. Milner Metal Forming Co., 3325 Regent Rd., Cleveland.



FOUR-EDGE PLANE provides you with a sharp blade at all times. When one side of the square cutter becomes dull, you turn it to another edge, and when the fourth edge wears, the blade can be replaced. The plane with one blade sells for $3.29; replacements, 98 cents each. Sears, Roebuck & Co., 925 S. Homan Ave., Chicago.

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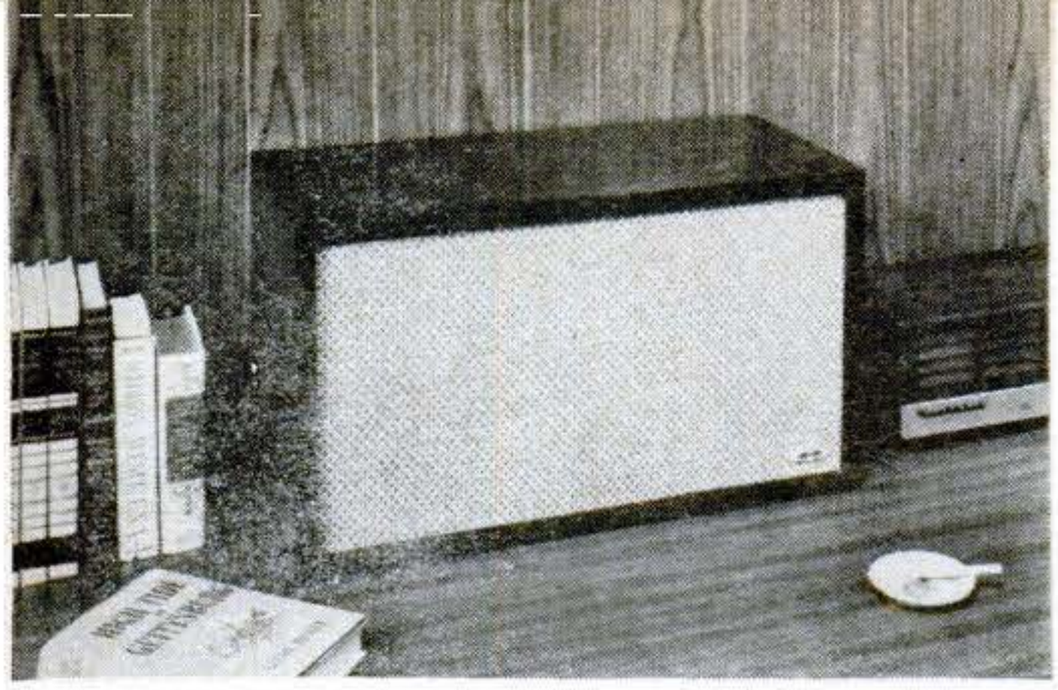


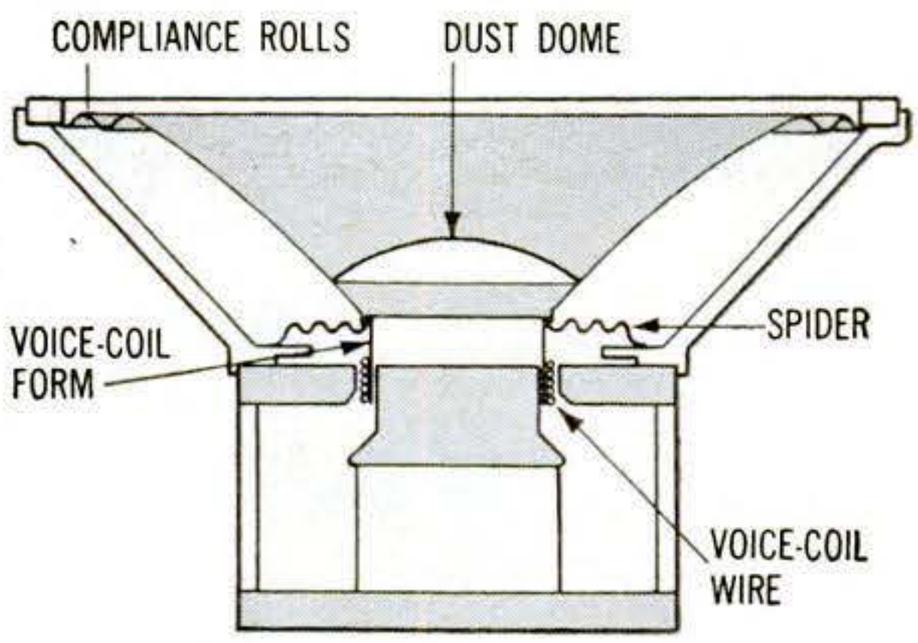
Hottest News in Hi-Fi: Compact

By Robert Gorman

THE private world of hi-fi fans is being turned topsy-turvy these days by an innocent-looking little box you can tuck into a bookshelf. The box and what's inside form a new breed of loudspeaker systems. The kind of wall-thumping bottom bass and the growling low notes that these little speakers can deliver is upsetting a firmly entrenched hi-fi doctrine that to get big bass you must have a big speaker and a big box to go with it.

Compact speakers have been blasting their way to the top in sales. Practically all speaker manufacturers—including many who still take a dim view of compactness—are scrambling to get their own versions before the public. The reasons aren't hard to find:

- The stereo boom has doubled speaker requirements. Hi-fiers who could just manage to budge one large enclosure into their living rooms have balked at the idea of finding room for two.
- The relative inefficiency of compact speakers is of less concern, now that more powerful amplifiers are common in most hi-fi rigs.
- These little speakers really deliver true, bottom-bass tones; they don't just simulate a bass sound, as is often the case when a conventional speaker is simply housed in a small cabinet.



HIGH-COMPLIANCE SPEAKERS used in compact systems look and work like conventional dynamic speakers, but differ in structural details. Reaction between a fixed magnetic field supplied by a permanent magnet and the signal current flowing through the voice-coil winding pushes and pulls the diaphragm. The motion of this cone diaphragm produces the sound waves. Suspension of the moving system is made extremely free-moving to make up for the stiffening effect of the air spring.

How they differ. Unfortunately the industry has not agreed on a generic name for the compact speakers. But they should not be confused with speakers that are simply physically small. The difference is like that between a small economy car and a high-performance sports car that happens to be small. The speaker designers make no apologies for lack of bulk. They invite you to compare absolute performance against the biggest speaker you'd give house room to.

The bomb that is still shaking the loudspeaker industry was dropped by a newcomer to the speaker-manufacturing business. Toward the end of 1954, Acoustic Research, Inc., demonstrated a new type of speaker, described by its inventor, Edgar Villchur, as a "revolution in acoustics." He called its underlying principle Acoustic Suspension.

The now-celebrated AR-1 housed a 12-inch woofer in a sealed box enclosing only 1.7 cubic feet of air and measuring only 11½ by 14 by 25 inches.

The AR speakers created an immediate sensation in the audio world. They won rave notices from music critics and were adopted as a reference standard for bass reproduction by several independent testing laboratories.

How they work. The basic principle has a simplicity that makes you wonder—after it's explained—why you didn't think

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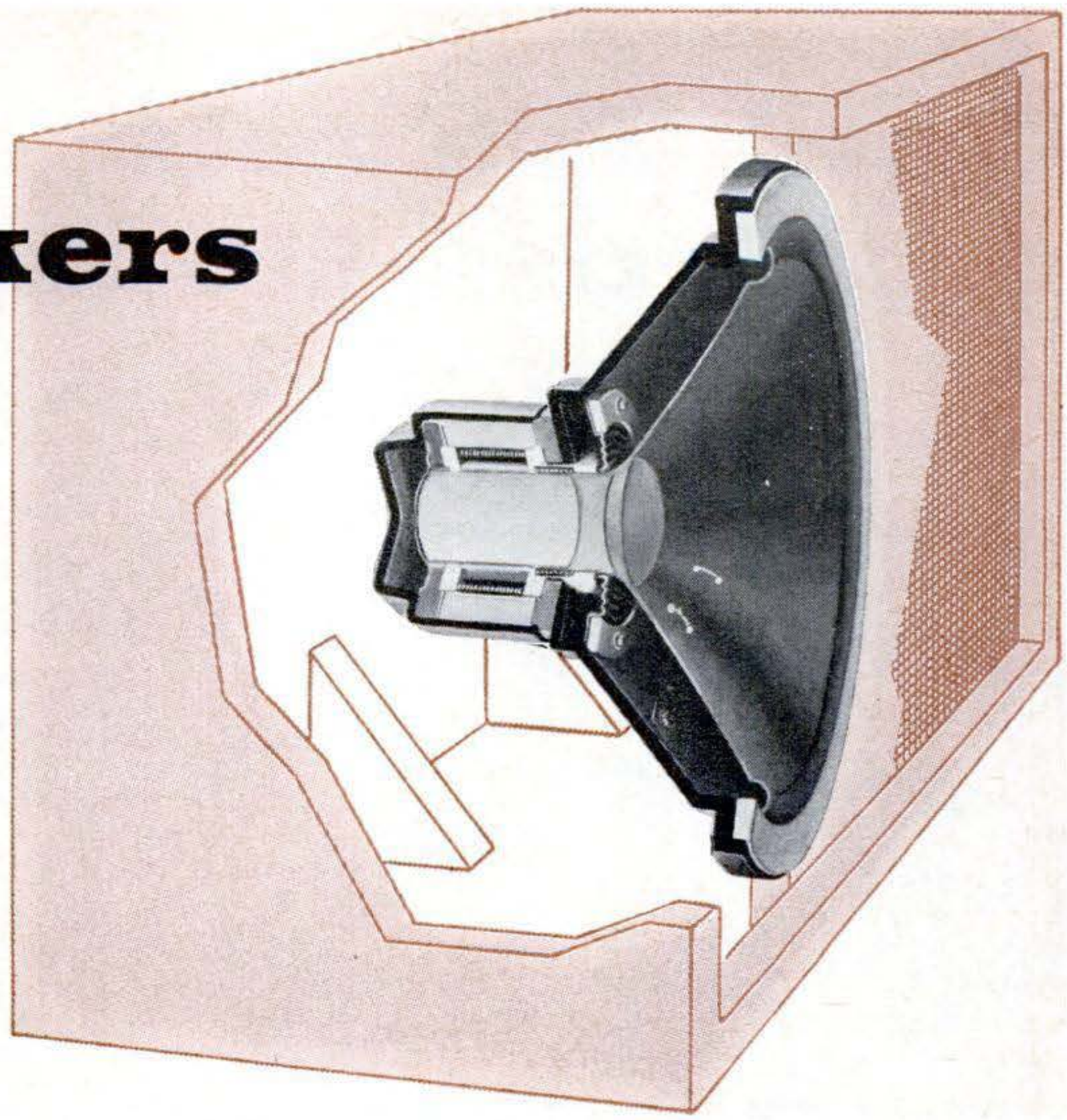
Speakers



COMPACT SPEAKERS come as complete units. Acoustic properties of enclosure must exactly complement electro-mechanical action of driver for proper reproduction of very low frequencies. Two types of enclosures are used: sealed, air-tight cavity in which the trapped air is designed to be a very linear element in the speaker suspension; and vented enclosure, which is tuned to resonate at some low frequency and thus allow a more efficient speaker design.

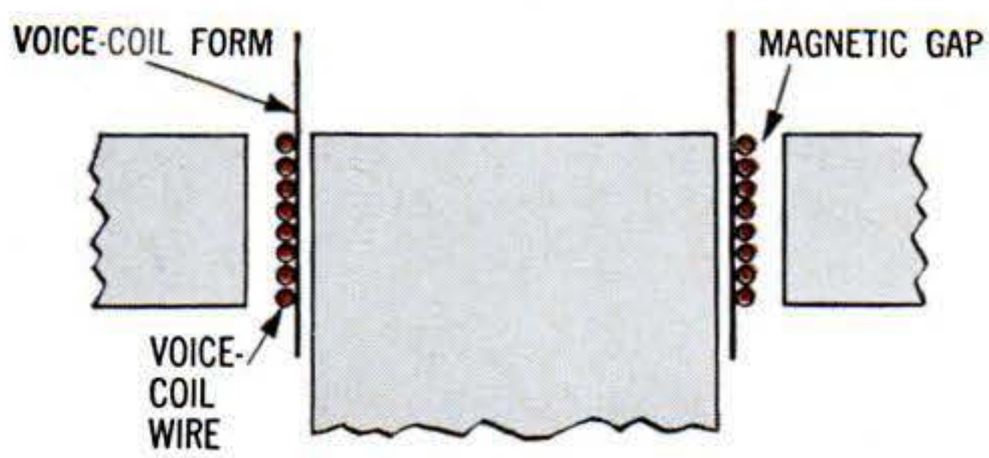
of it yourself. It's another application of the if-you-can't-lick-'em-join-'em philosophy of design.

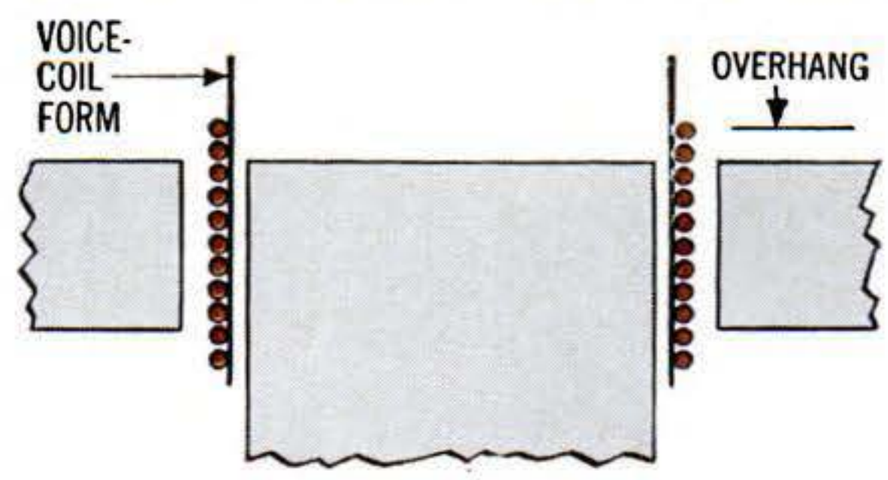
In a small enclosure, the stiffness of the air trapped behind a conventional speaker is one factor in choking off the low frequencies. The air acts like a spring to oppose the motion of the speaker cone. Villchur turned this handicap into an asset.

All speakers must have some sort of spring to provide restoring force to the speaker cone. Ordinarily, relatively stiff mechanical springs (conventional cone-edge support and voice-coil spider) do this job.

He deliberately made his mechanical suspension loose enough to let the trapped air furnish most of the needed springiness. Thus the small enclosure became a vital part of the speaker mechanism—its smallness essential for proper operation rather than a limitation on perform-

[*Continued on page 277*]





VOICE-COIL EXCURSION can be increased by making the voice-coil winding longer than the magnetic gap. Thus the voice coil can move forward and back by the amount of the overhang and still keep the same number of coil turns immersed in the magnetic field. But the turns outside the magnetic field do not add to the driving force and so reduce efficiency. Different makers have chosen widely differing compromises to meet the problems of efficiency, distortion, and achievement of maximum bass power.

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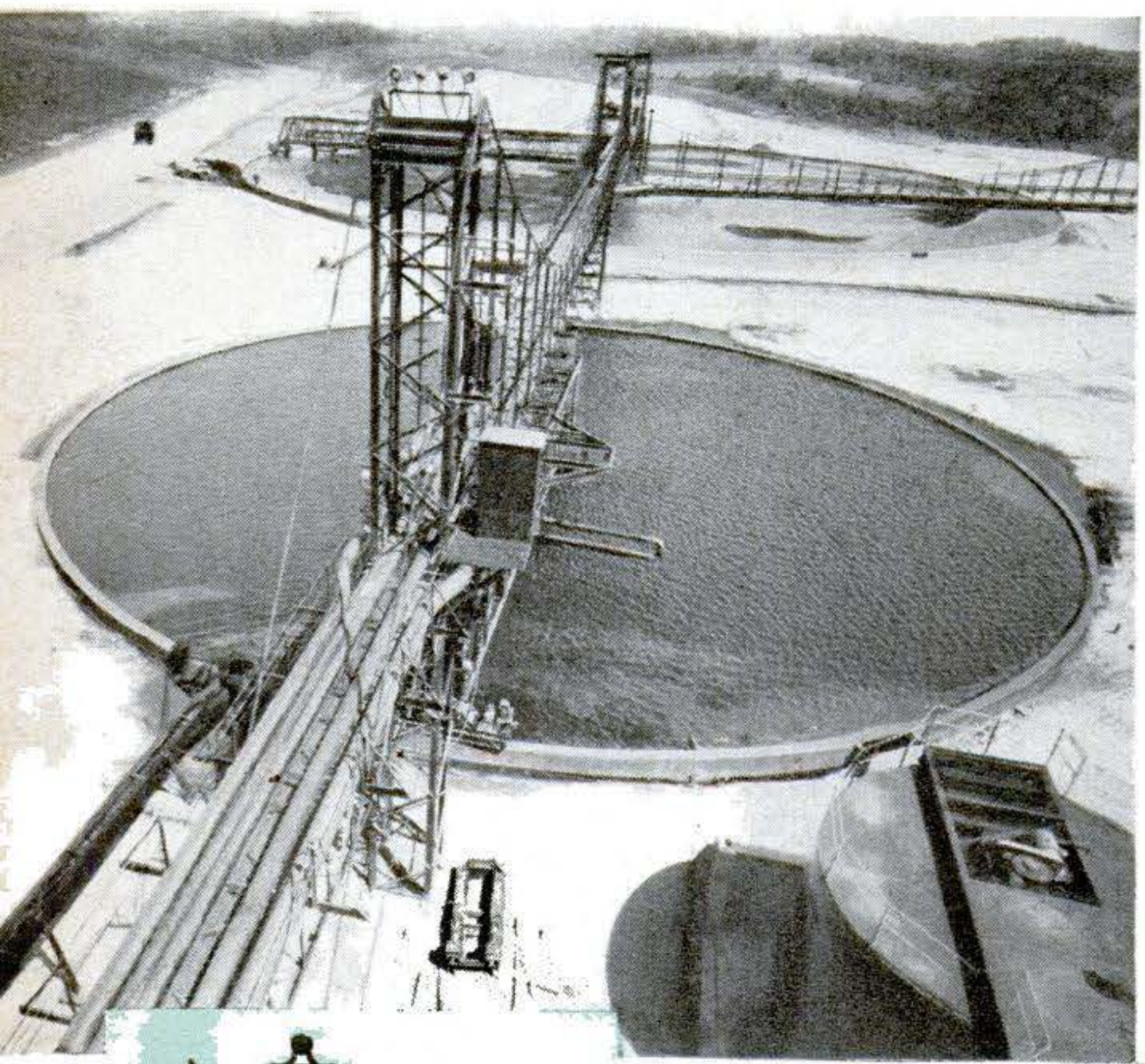
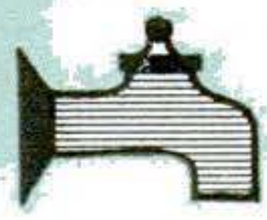
Coal Travels Cross-Country Through a Tube



By making solid fuel and ore flow like water, long-distance pipelines to transport them now vie with rail and road

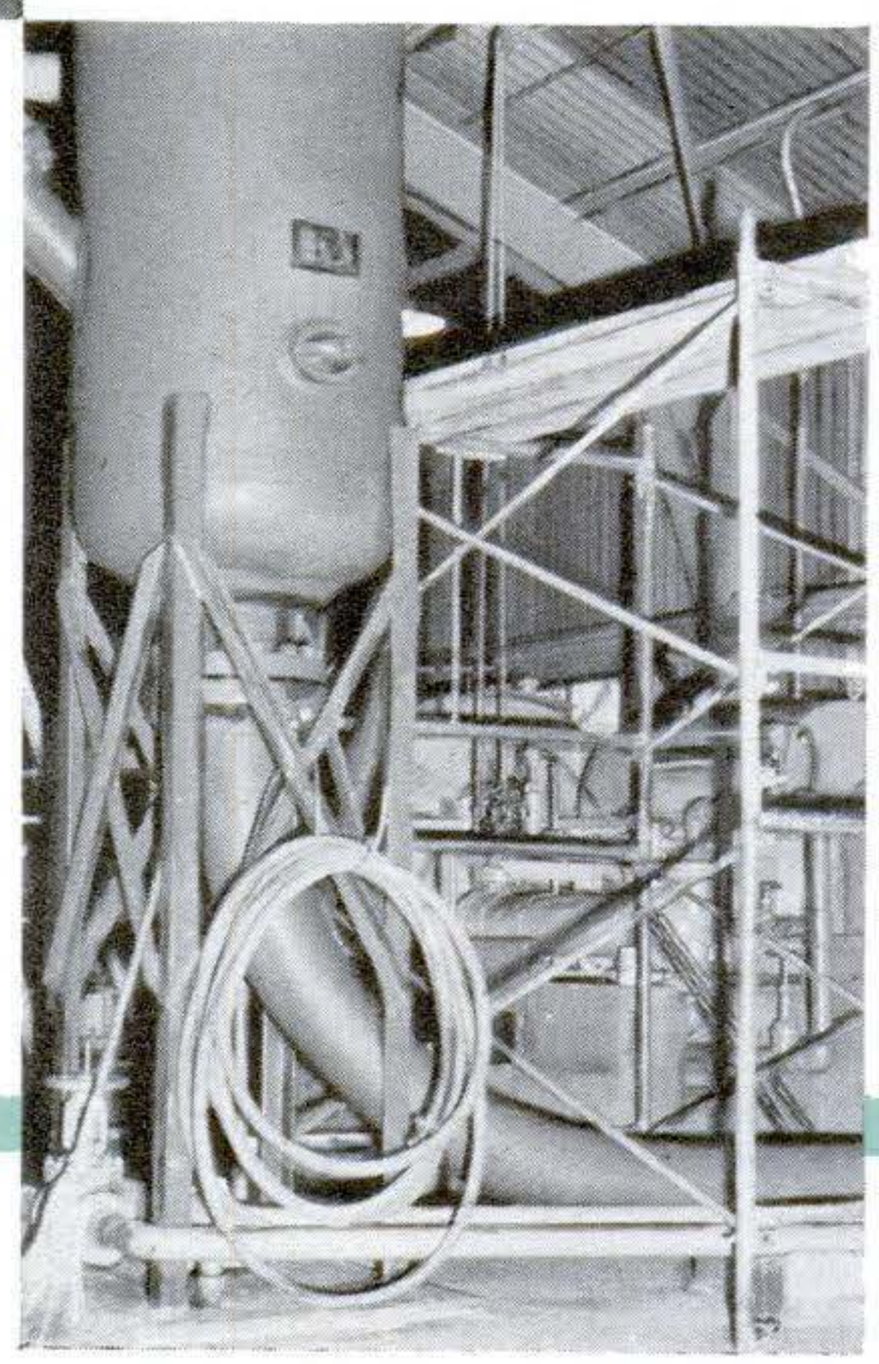
By Alden P. Armagnac

HOW COAL IS PIPED is illustrated by 108-mile Ohio line. At its start near Cadiz, a preparation plant pulverizes soft coal from nearby mines, and mixes it half-and-half with water—forming an inky-black soup, called a "slurry," that can be pumped. Storage basins (photo at left) keep the coal-and-water mixture agitated to prevent settling-out, and provide a continuous supply of it, around the clock, to the inlet end of the pipeline.



WATER IS MIXED WITH POWDERED SOFT COAL

PUMPING STATION (photo at right) starts waterborne coal on its way north from preparation terminal. Curving pipe, at bottom of photo, is first link of long cross-country pipeline. Two more pumping stations, at Carrollton and Atwater, successively give the coal-and-water mixture a boost. Route, upgrade for 60 miles, then becomes level.



INKY-BLACK FLUID THEN GOES TO FIRST OF THREE PUMPING STATIONS

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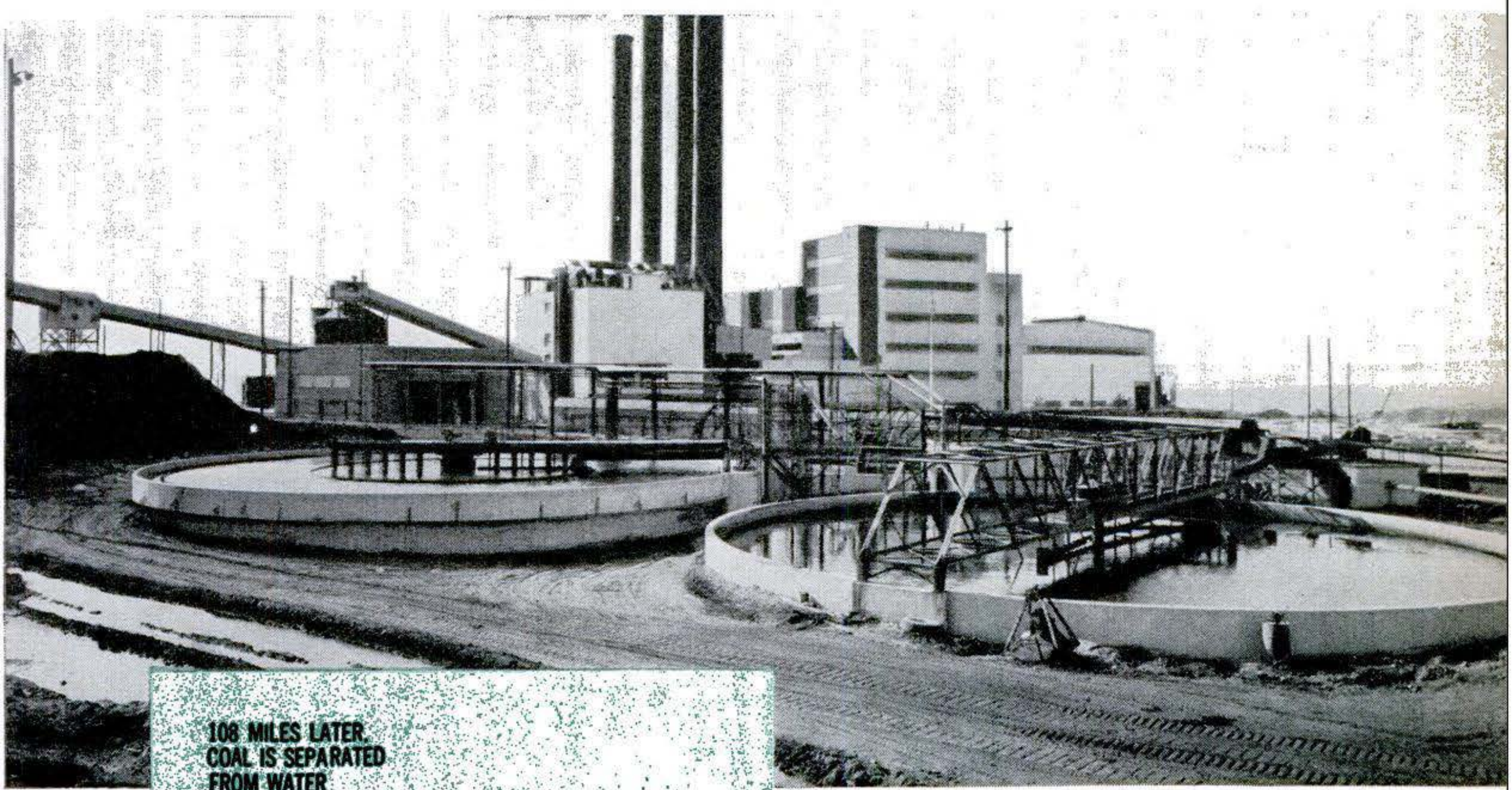
NOW they're talking of pumping coal through a 24-inch pipeline, stretching 350 miles from West Virginia to New York City. If tentative plans materialize, the proposed tube would carry a continuous stream of solid fuel, straight from the mines, to the boilers of some of the East's largest steam-electric generating plants. It could be built in three years, engineers say.

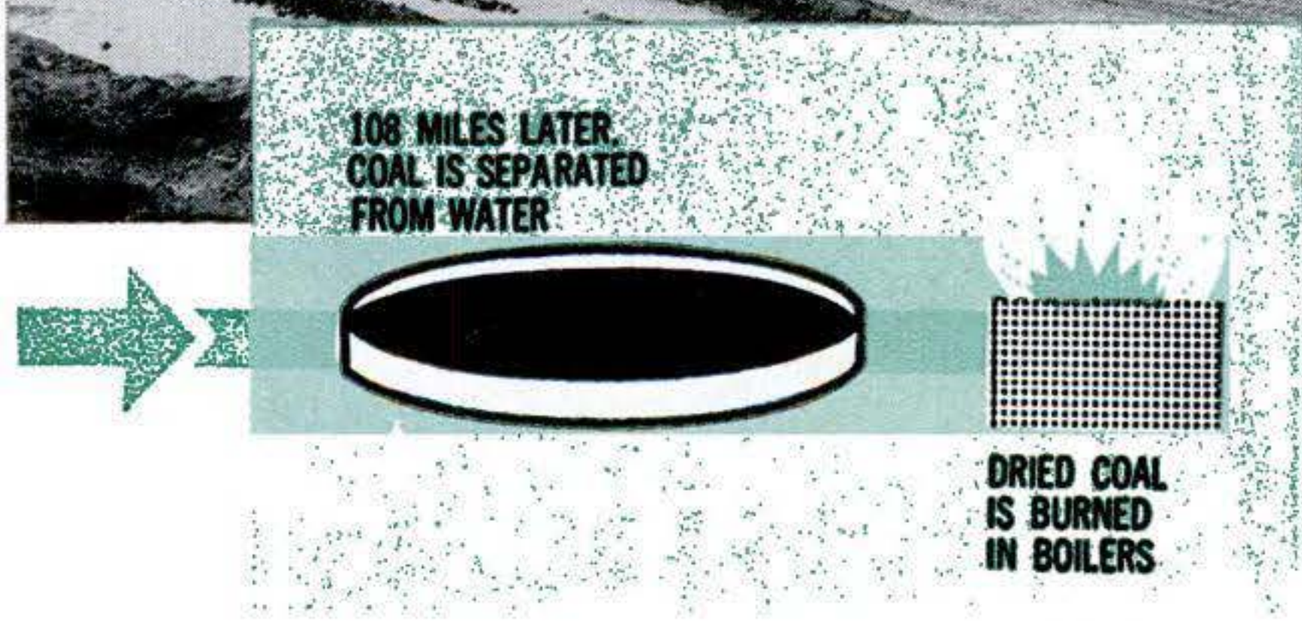
Big names in industry are linked with this grand-scale proposal. The Consolidation Coal Company of Pittsburgh would supply the fuel. The Texas Eastern Transmission Company would build the line. Prospective customers, reportedly interested and studying the idea, would include the Consolidated Edison Company in New York, and major utility firms in New Jersey and Pennsylvania. Whatever may come of it, the scheme's far from visionary.

Coal travels by pipeline already. So do solid materials of surprising variety—coffee beans, limestone, fish, wood chips, clay, ashes, phosphate rock, ores of metals and other valuable minerals.

Today's "solids" pipelines, it's true,

PIPELINE FOR COAL, shown being laid across the state of Ohio, now operates 24 hours a day. It carries 1,700,000 tons of fuel yearly from mines to the power station that serves Cleveland.





ARRIVING AT DESTINATION, coal goes through "de-watering" process. Collected in settling basins (foreground of photo above), coal then gets wrung out by vacuum filters, and warm air completes drying it for use in big Eastlake power station (background of photo).

CONTINUED

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Pipelines for solid materials have lately donned seven-

are often as modest in scale as one that carries sardines from a fishing-boat dock to a cannery at Portland, Me. Their total length doesn't compare with the 600,000 miles of oil and gas pipelines crisscrossing the U. S. None can boast any such dimensions as the length of the Texas-New York "Big Inch," or the 55-inch diameter of the biggest natural-gas pipe—so far, let's add.

For, within very recent years, pipelines have begun carrying solid materials on impressively long trips. A coal pipeline spanning Ohio currently holds the 108-mile record. Successfully operated for more than a year, it would be the model for the bigger one now proposed.

How it's done. You can't just put solid coal, or rock, or ore, in a long pipeline and force it along. Of course there's a trick to making it flow:

First you mix the solid stuff with a fluid—water or air. Then you can pump it or blow it through a pipe. At the receiving end, you separate the solid material from the fluid. For this to work, the material must usually, though not always, be in pulverized form.

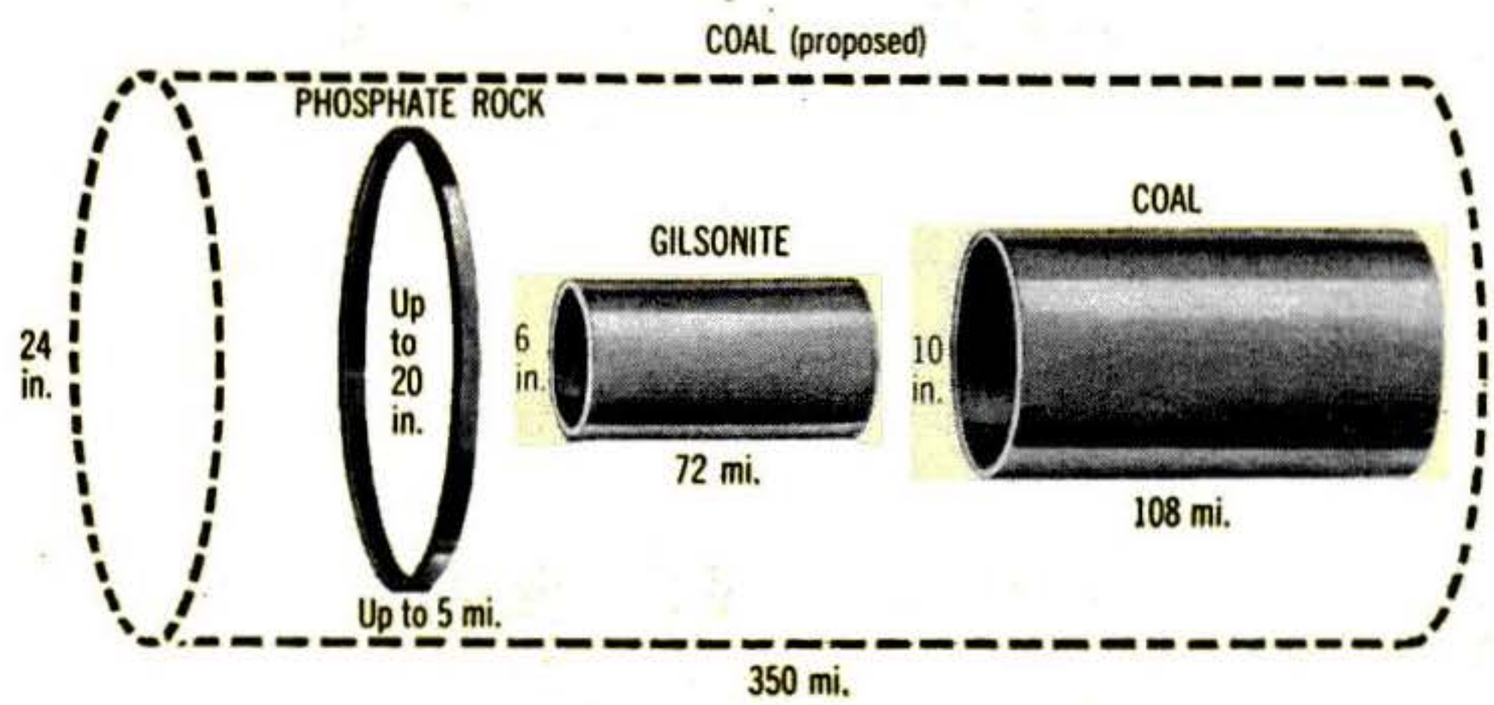
The idea was first applied to an eight-inch, 1,750-foot hydraulic pipeline for coal, built in England as early as 1914. Winding around buildings that blocked the way of a mechanical conveyor, it carried fuel from a Thames dock to a power station.

Since the 1930s, U. S. pipelines from one to five miles long, and up to 20 inches in diameter, have carried phosphate rock for fertilizer from mines to mills. Water rushing through the steel pipe at more than seven-m.p.h. speed, it proved, would carry along even coarse lumps of uncrushed rock. Now 20 phosphate-rock pipelines, mostly in Florida, convey 40,000,000 tons yearly—the most tonnage of any solid commodity being piped.

The 1940s and early 1950s saw "solids" pipelines grow only a little longer. A French pipeline for coal reached six-mile length. Twin eight-inch wooden pipes carried waterborne nickel ore on a trestle across 7½ miles of Canadian wilderness. In Georgia, a 10-mile hydraulic pipeline for clay went into service.

The big push. Pipelines for solids donned seven-league boots in May, 1957, with the opening of a pioneering 72-mile tube that has proved a brilliant success. Gilsonite, a shiny black asphalt-like rock that yields gasoline and coke, is its cargo. Carrying this "gasoline ore" in a stream of water, the American Gilsonite Company's six-inch pipeline begins at its mine in a mountainous desert at Bonanza, Utah. Climbing eastward over the Book Cliff Mountains, it descends on the Colorado side to a new refinery near Grand Junction. Daily it delivers 700 tons of the mineral, to be converted into 1,300 barrels of high-octane gasoline and 250 tons of premium-quality coke.

The $2,000,000 pipeline's builders had recognized that they had an almost ideal material to transport by pipe. Gilsonite was nearly light enough to float (specific gravity, only 1.04), so it would mix well with flowing water. In fact, the mine already pumped the crushed, sooty stuff to the surface in water, and it needed only a little finer pulverizing to be ready-made for going into a long-distance pipeline. A soft mineral, it couldn't abrade and wear out the steel pipe; exceptionally pure, it wouldn't corrode the pipe, either.



AT A GLANCE, here are comparative dimensions of some of biggest U. S. pipelines now carrying solid materials—and of proposed 350-mile, hydraulic-type pipeline for coal. (Diameter and length are shown to different scales.) Longest so far, 108-mile Ohio pipeline for coal sets precedent for much bigger one projected.

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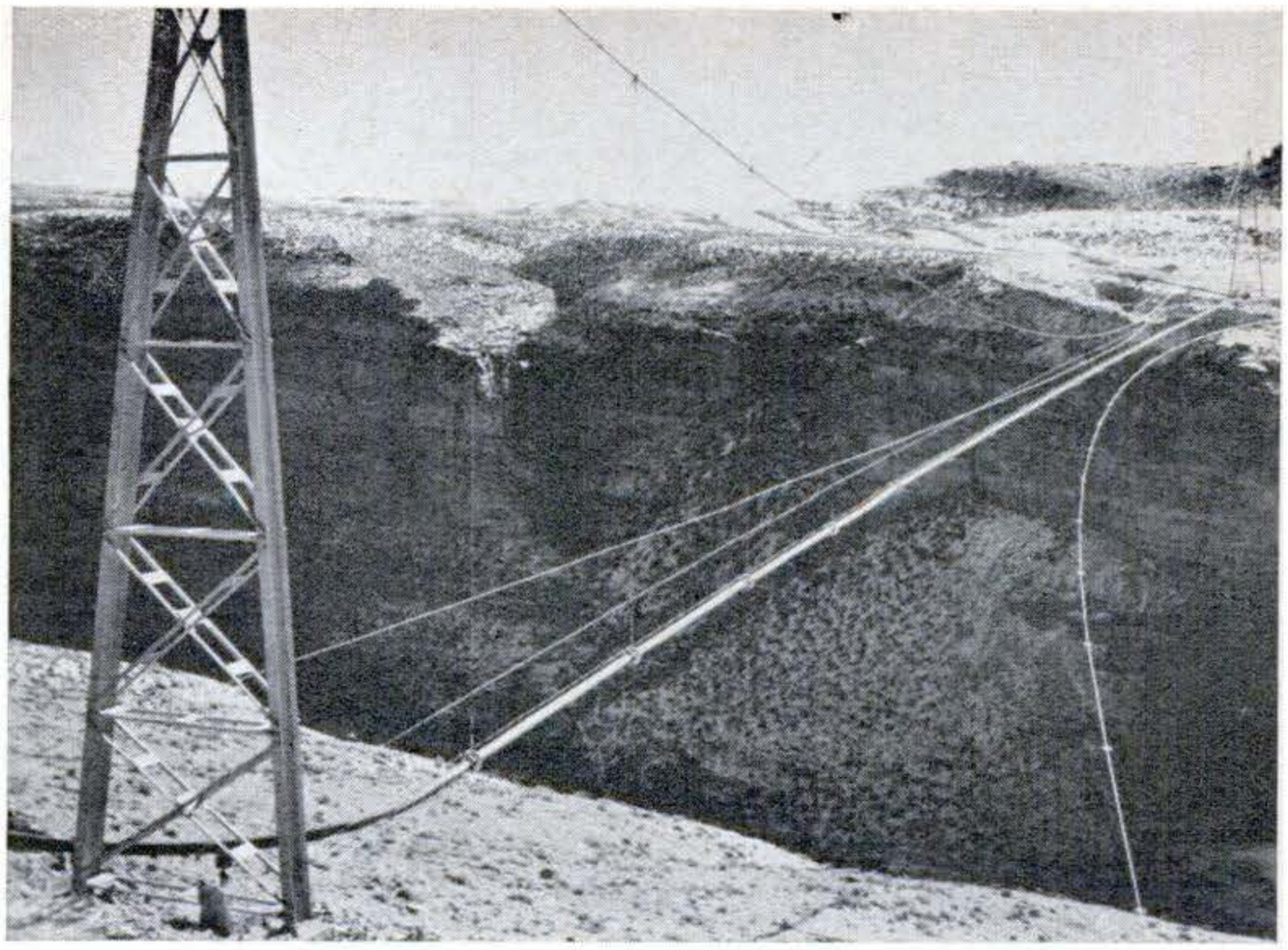

GILSONITE, above, is carried 72 miles in water through Utah-Colorado pipeline at right. Photo shows insulation-wrapped pipe at one of two places where it emerges from ground, to leap canyons 600 to 700 feet wide. Rest of pipeline is buried to protect it from freezing.

Anticipating emergencies. What if a breakdown in the single pumping station at Bonanza should stall the three-m.p.h. flow through the pipe? Engineers foresaw a risk that the mineral might settle out of the water, and slide downgrade to low places, clogging the tube. So atop Baxter Pass, the line's highest point, they provided an artificial lake to flush the whole line clear of solid particles in such an emergency. Actually used several times, this foresighted provision has permitted brief shutdowns for minor repairs, and resumption of pumping without a hitch.

The record-holding 108-mile Ohio pipeline for coal, which began full-scale operation in 1958, is half again as long as the Utah-Colorado one. It carries five times the tonnage. Propelled by a pumping station at its beginning, and two more along the way, an inky-black "slurry" of powdered coal and water flows through it 24 hours a day.

Up hill and down dale, the pipeline runs northward from Consolidation Coal Company's mines near Cadiz and the West Virginia border. It ends at Cleveland Electric Illuminating Company's Eastlake power station on the Lake Erie shore, just east of Cleveland. Daily the single 10-inch pipe delivers 4,600 tons of soft coal, enough to fill a train of 65 hopper cars. It does it at an estimated saving of up to $1.50 a ton, compared with the cost of rail transportation.

Buried at least four feet deep so it won't freeze, the pipeline lies hidden from view almost all the way, but pops up into sight at the wayside pumping stations. Put an ear to it, and you hear a new sound of the mid-20th century—the sound of fluidized coal rushing cross-country, to light the lamps and turn the wheels of a metropolis.

Genuine pipe dream. Most exciting of its kind to engineers, the Ohio coal pipeline took nine years to bring into being. Its story was one of challenging problems, false starts, and ultimate triumph.

Seeking ways to curb the rising cost of hauling coal, Consolidation researchers in 1949 became interested in the possibilities of piping it. Trials of a 200-foot working model of a coal pipeline, and then of a larger one, were promising. In 1953, Consolidation consulted the New York engineering firm of Ford, Bacon & Davis on the feasibility of a long-distance pipeline for coal. The report was favorable and Consolidation decided to build the Ohio line.

In 1954 it signed a contract with Cleveland Electric to supply 80 percent of the 670,000-kilowatt Eastlake plant's fuel needs, more than a million tons of coal yearly, for 15 years. Then came acquiring the pipeline's right-of-way; laying the pipe; and building plants to prepare the coal, to pump it, and to "dewater" it at the receiving end.

Workers laid the last section of extra-heavy steel pipe in July, 1956. Designed

[*Continued on page 238*]

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At a lakeside camping site, the fiber-glass top comes off.

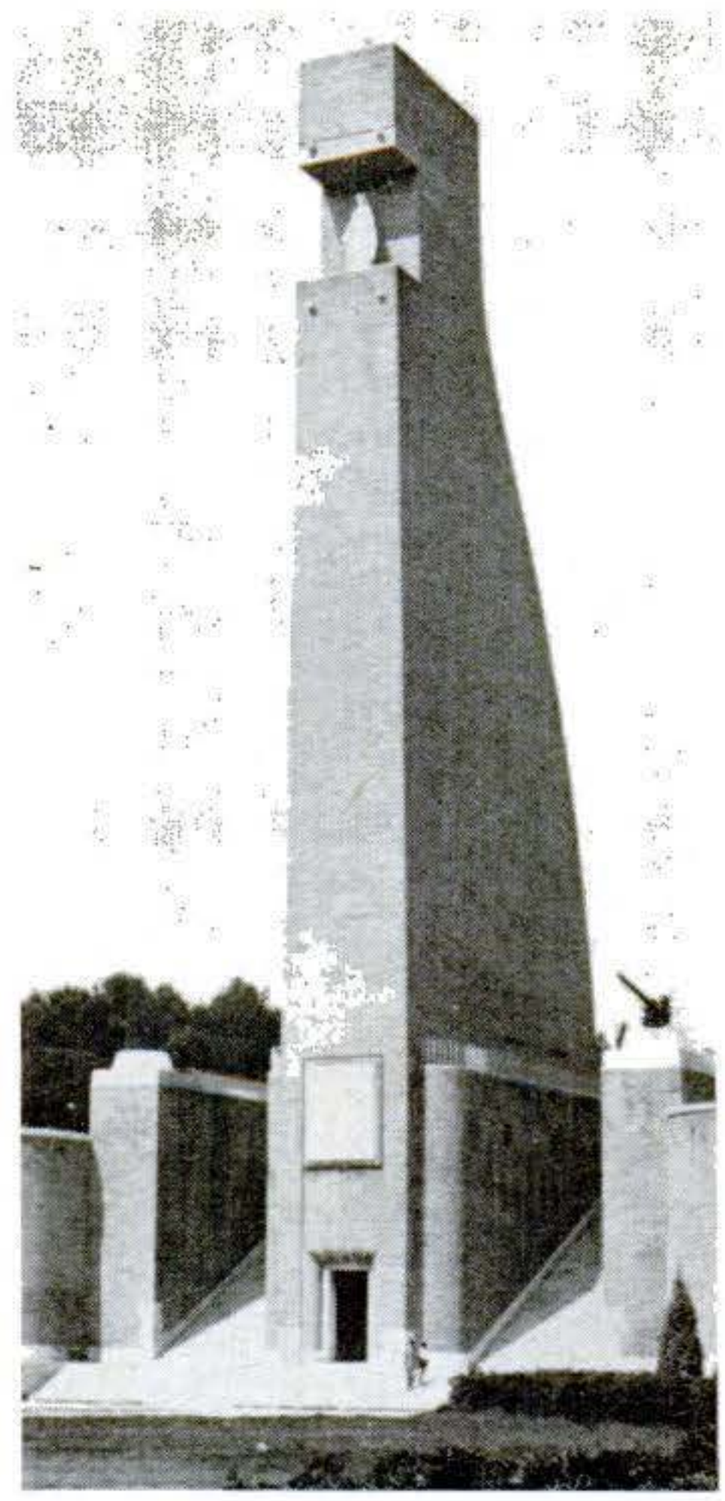
Separated, the lid is a boat, the bottom sleeping quarters.

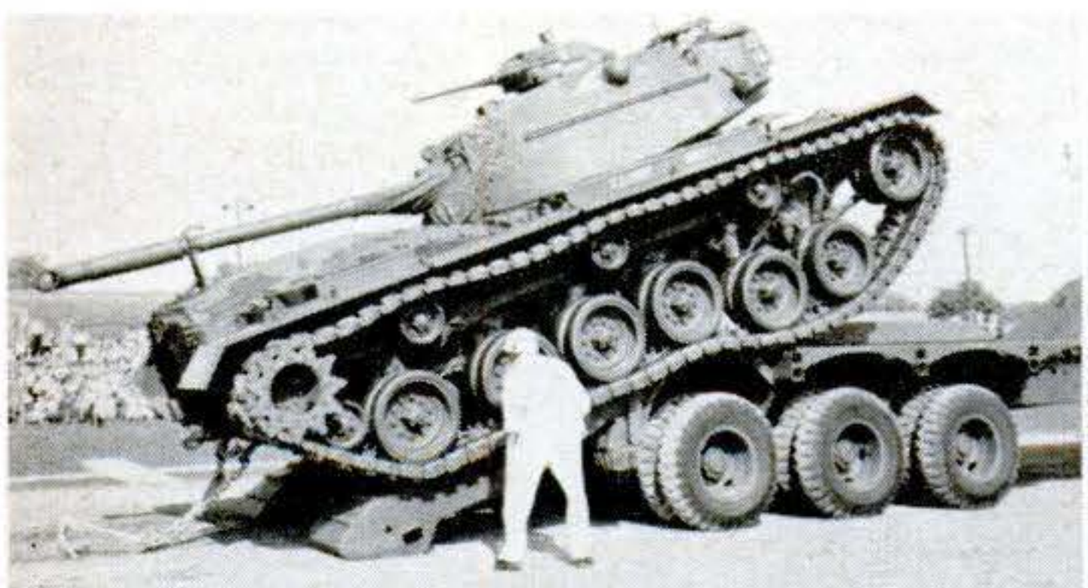
Half boat and half tent

Here's a trailer for overnight fishing trips. The lid is a boat that can be used with an outboard or oars. The six-foot-four bottom serves as a base for a collapsible metal frame and a canvas covering. It will sleep two men. Nylon-screen windows and weather flaps keep out insects and storms. A family-size extension is optional. Knight Mfg. Co., Atlanta, Ga., makes it.

Naval memorial

The imposing monument below is built in the shape of a ship's rudder. In a niche near the top is a 13-foot statue of the Madonna. Standing near the Bay of Naples, the 200-foot structure is a memorial to Italy's naval war dead.





For hitchhiking tanks

This rubber-tired experimental trailer provides fast highway travel for Army tanks. Top road speed of the truck tractor hauling it is 40 m.p.h. with a 60-ton load. A heavy ramp is dropped to let a tank climb aboard, then pulled back into upright position by a grappling hook attached to the rear of the tank itself. If the tank is disabled, it can be loaded by means of hydraulic winches.

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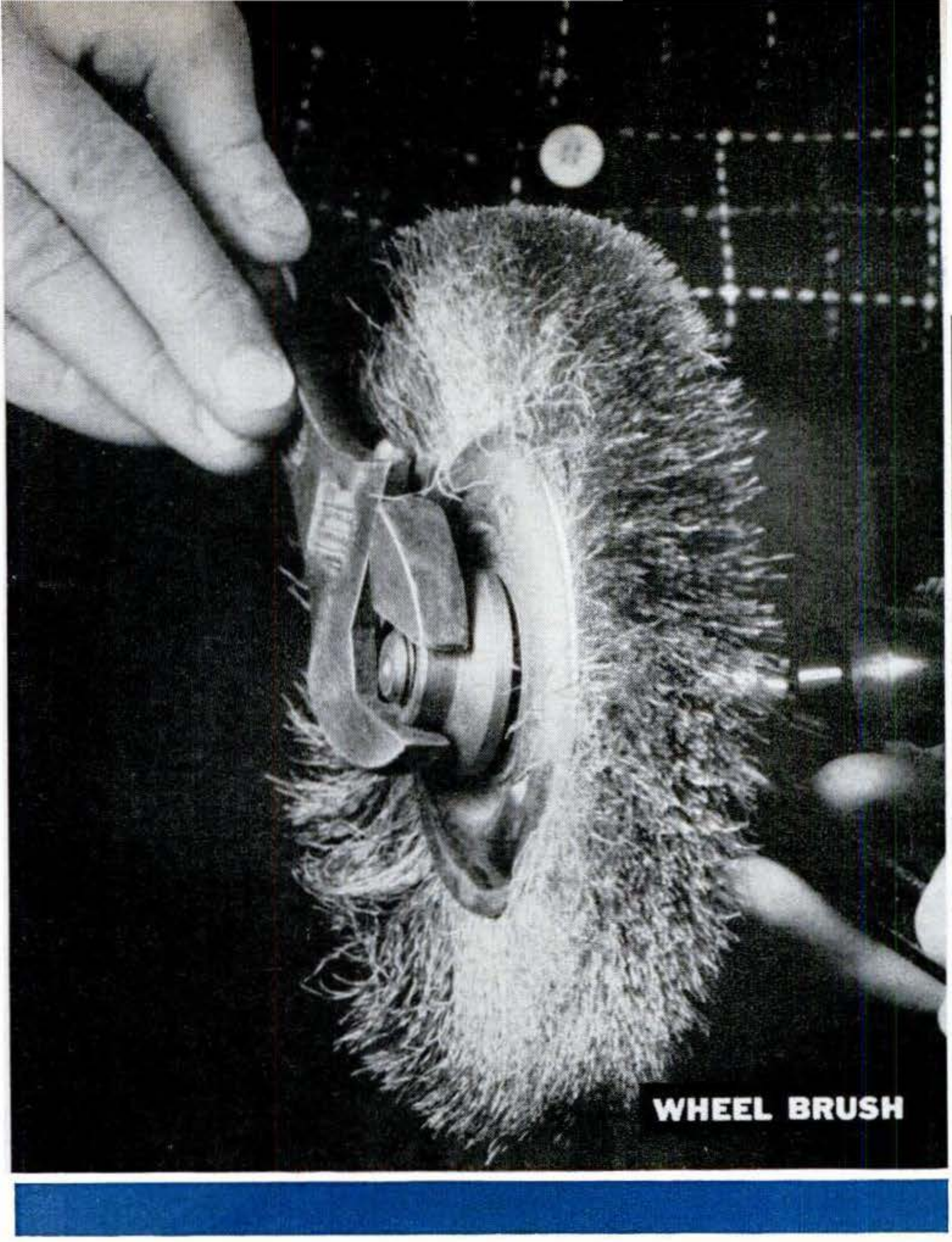
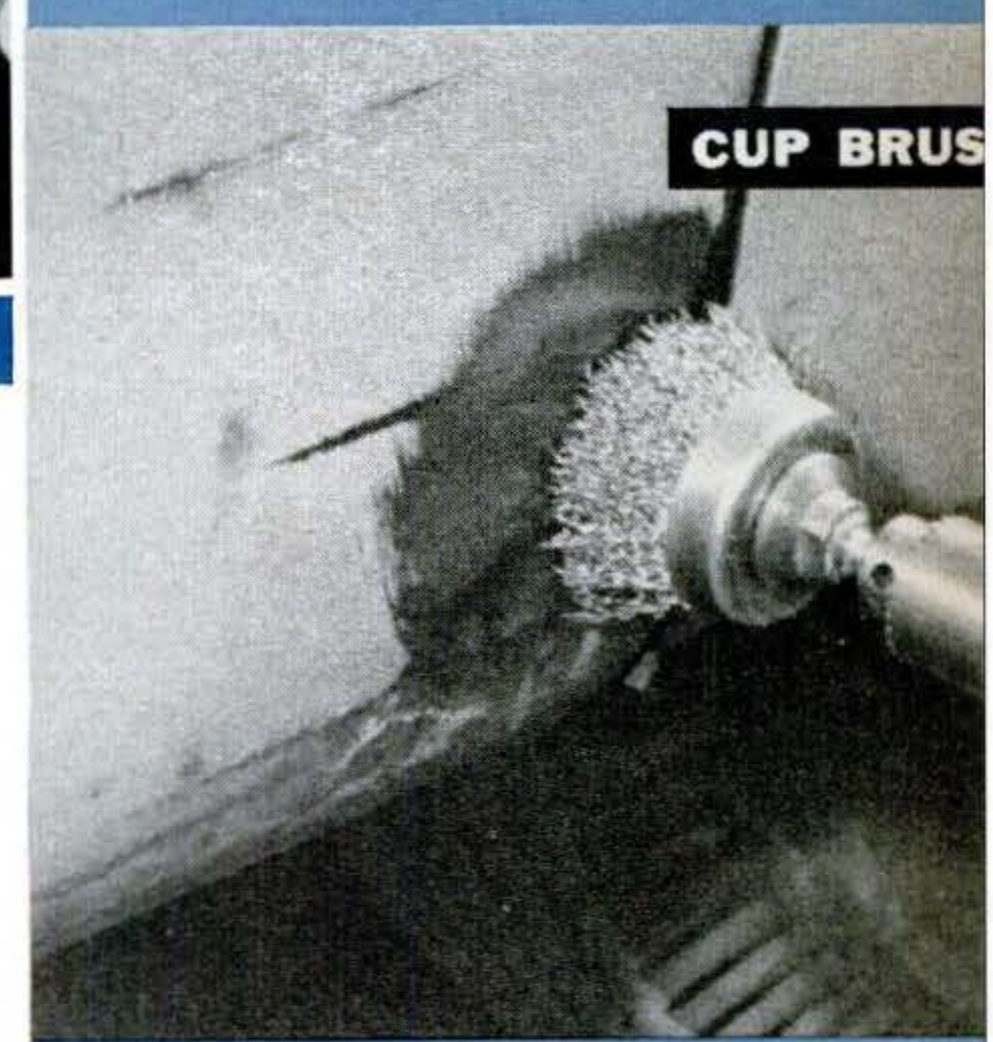
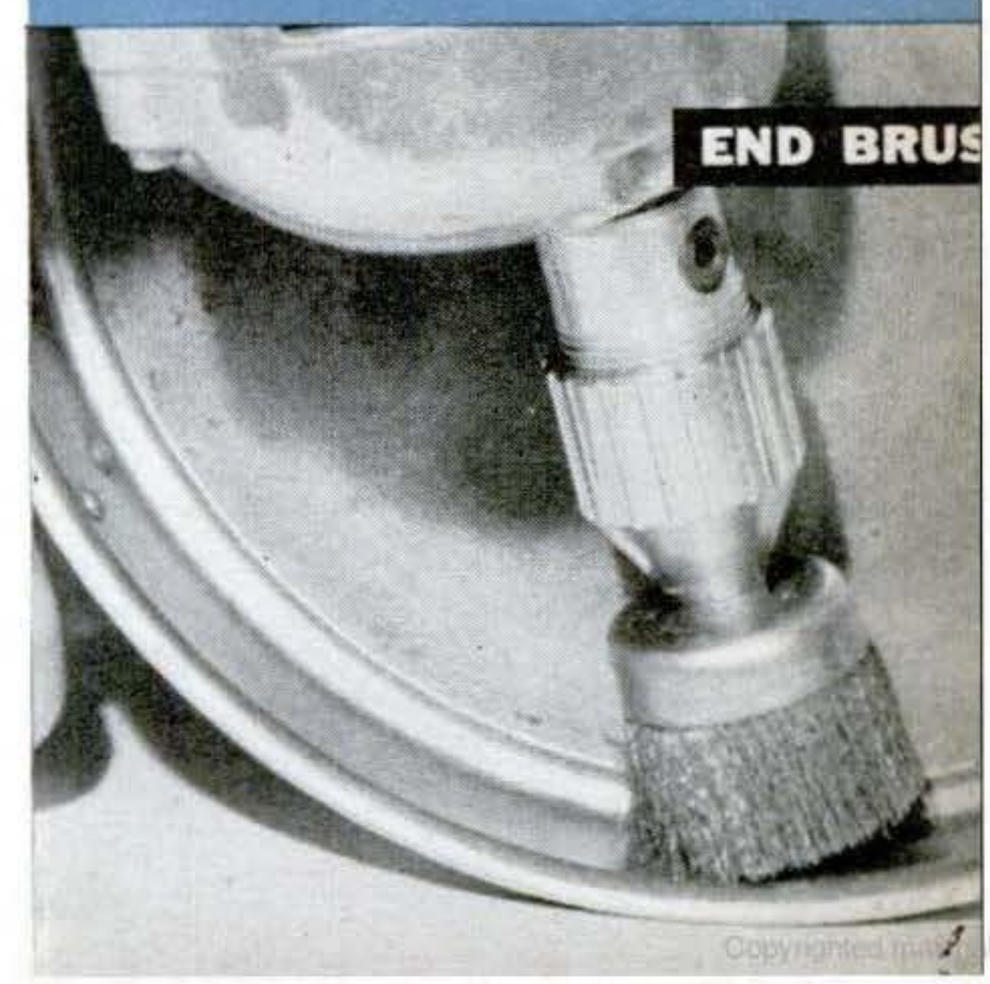

WHEEL BRUSH

HAND BRUS


CUP BRUS


END BRUS

Wire Brushes for the Home Shop

By Darrell Huff

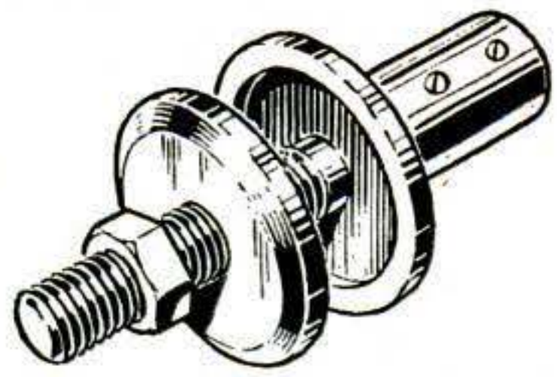
ONE of the hardest-working tools in your shop can be a wire brush—if you have one and know how to use it. If you don't, the hardest-working thing in your shop may be *you*.

A wire brush is one of the biggest dollar's worth of elbow-grease saver you can buy. Five

CONTINUED

Three ways you can mount a power brush

USE A DRILL ARBOR when you want to mount a wheel or cup brush in a chuck. This clamps the brush between washers and has a stem that fits into a chuck on an electric drill, drill press, or flexible shaft. Arbor can be bought for about 75 cents.



USE A MOTOR WORK ARBOR when you want to drive a wheel or cup brush directly from a motor shaft. You can buy one with a collar to fit a ½″ or a ⅝″ motor shaft. Most arbors take brushes with ½″ holes, cost approximately $1.25.

USE A CHUCK on a motor work arbor when you want to drive an end or side brush from a motor shaft. These brushes come with stems instead of holes and thus require a chuck to hold them. Arbor will also take other brushes between washers.

basic types of brushes will handle just about any cleaning, scraping, or polishing job you have. Here's what they can do for you:

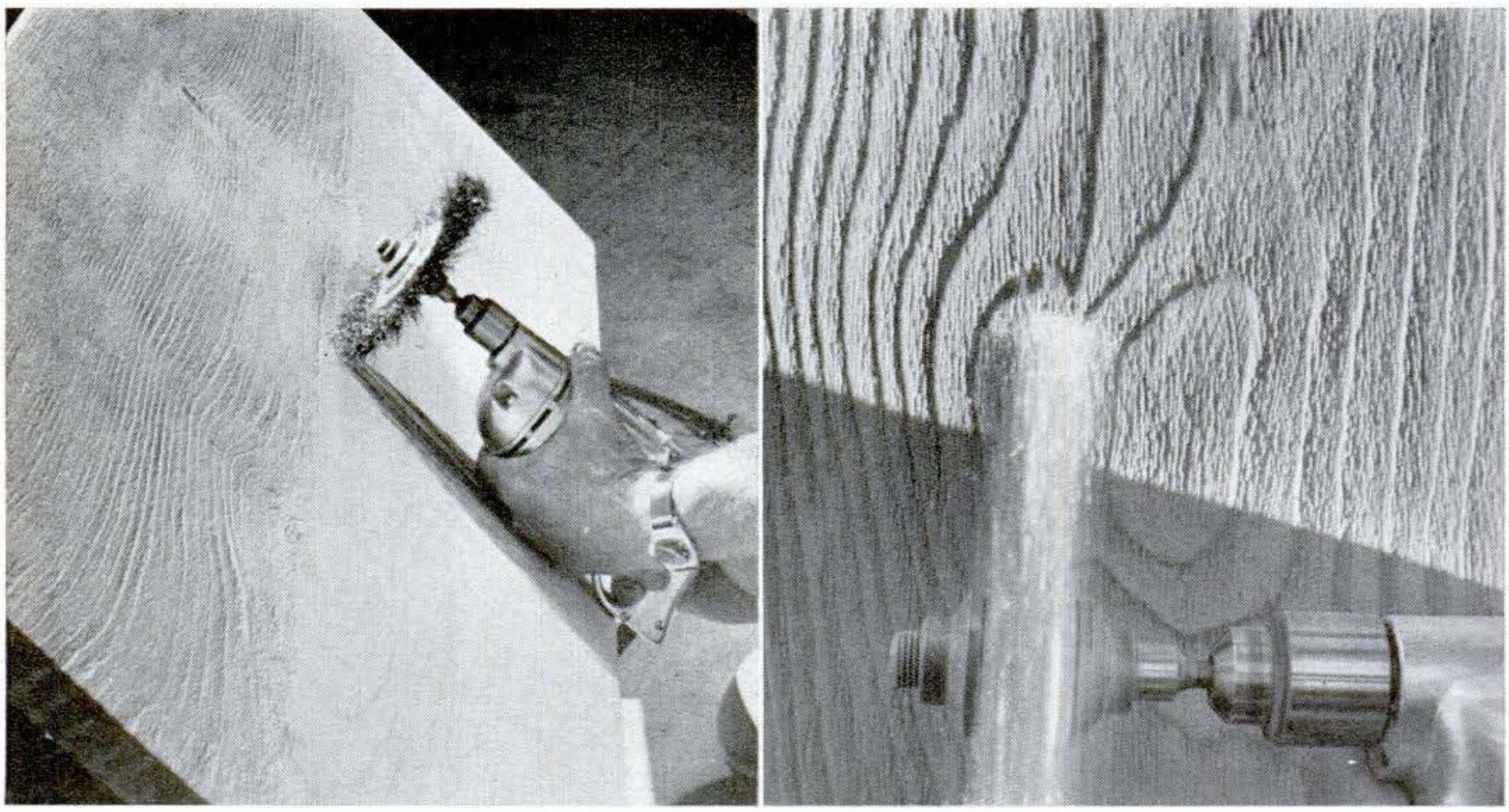
Hand-pushed scratch brushes can get in places where powered brushes often can't reach, and are good for quick or awkward jobs. You can get long, slim brushes that come with handles or big flat ones that look like scrub brushes.

One of the handiest types is about 1″ wide and 6″ long. Use a small brush like this to clean files, castings, pipe threads, bolts, and other hardware. It will also get in and around battery terminals, brush out soldered joints, and remove paint from hard-to-reach spots.

The big scrub-brush type is good for large, flat areas. The most common size is about 2½″ by 7″. This is ideal for removing blistered paint before painting a house. It knocks off the loose flakes without harming the sound paint.

Wheel brushes are much faster than hand brushes when you can bring the work to them. You can mount a wire wheel on just about any power tool that has rotary motion—a drill press, grinder, polishing head, radial-saw arm, table saw —or directly on a motor shaft. For more

How to apply a wire-brush finish to wood



STRIKING TEXTURES can be given to table tops, built-ins, and other furniture by wire-brushing the wood. This scrubs away the soft grain, leaving a raised pattern of hard grain, as shown in the close-up at right. Job goes fastest with a powered wire wheel, but can also be done with a hand brush. Work only in the direction of the grain. Technique works well on most hardwoods and on softwoods that have a prominent grain, such as pine, redwood, and fir.

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Don't forget safety when you use a wire brush

portability, you can chuck a wheel in an electric drill or flexible shaft.

A 6″ wheel is best for all-around use on stationary power tools. Larger wheels may tend to vibrate. For portable drills and flexible shafts that have less power, keep wheel size to 4″ or under.

Use a coarse-wire wheel for rough cleaning, such as removing rust, stains, or scale. Household objects of pewter, copper, steel, or brass can be polished with the more gentle action of a fine-wire wheel. (Where a high polish is wanted, the final step should be done with a tampico fiber brush and a polishing agent such as jeweler's rouge.)

Cup brushes, as their name implies, are shaped like a cup and are made for cleaning and polishing flat surfaces. Use them on sheet metal, strap iron, pans, and rusted areas on auto bodies.

Cup brushes come up to 6″ wide, but the 2″ and 3″ sizes are most useful with home-workshop tools. Some have crimped wire for flexible finishing, while others have knotted wire for especially tough polishing jobs.

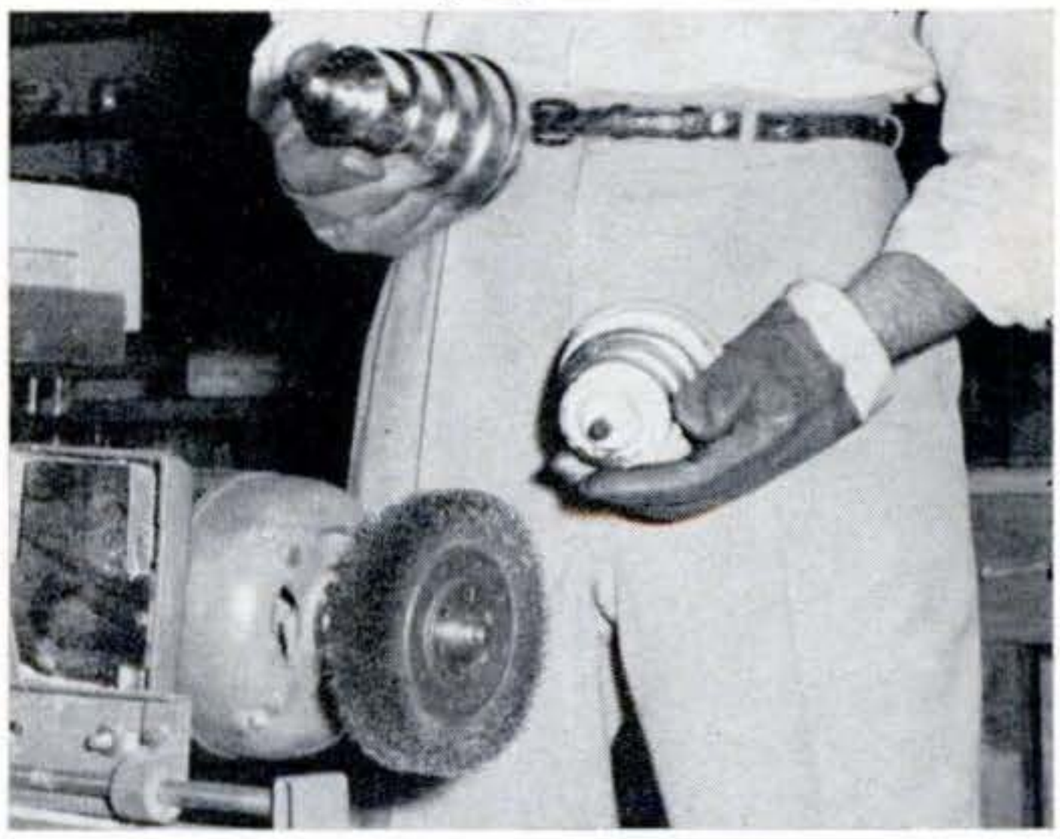
When buying a cup or wheel brush, be sure the mounting hole fits the tool you want to use it on. Most tool arbors and shafts take a ½″ hole, but some circular saws and large grinders require ⅝″ holes.

End brushes look similar to cup brushes, but are smaller and are solid in the center instead of hollow. You use them to get into hard-to-reach spots like the inside of a burned pot.

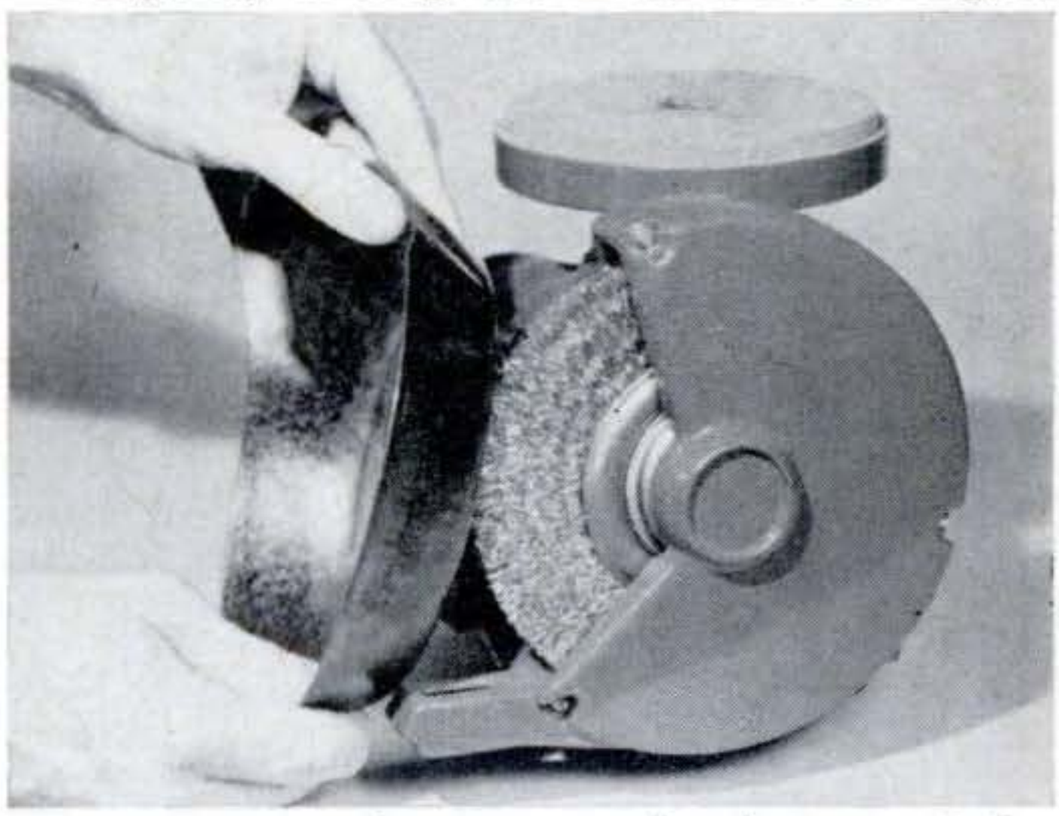
End brushes have ¼″ shanks instead of holes, so they fit directly into chucks on drills and drill presses. One variation, called a circular end brush, has more of a sideways action, like a wheel brush. This is used to clean the sides of cavities that might be marred by the arbor on a regular wheel brush.

Side brushes are tiny tufts of steel or brass wire mounted on small ⅛″ shafts. They get into places where no other brushes will go and are good for cleaning threaded holes, removing burrs from machined parts, or preparing small surfaces for soldering or welding.

WEAR GOGGLES for power brushing, especially when the wheel is turning at high speeds. And stand to one side so you're not right in line with loose wires that may fly off the brush.



PROTECT YOUR HANDS with gloves when working with small or hard-to-hold objects where your fingers may touch the wheel. Feed the work gently to keep the wheel from seizing it.



SAFEST MOUNT for a power brush is a grinder because of its wheel guard. When polishing plated objects, be sure you use a fine, soft brush to avoid unnecessary damage to the plating.

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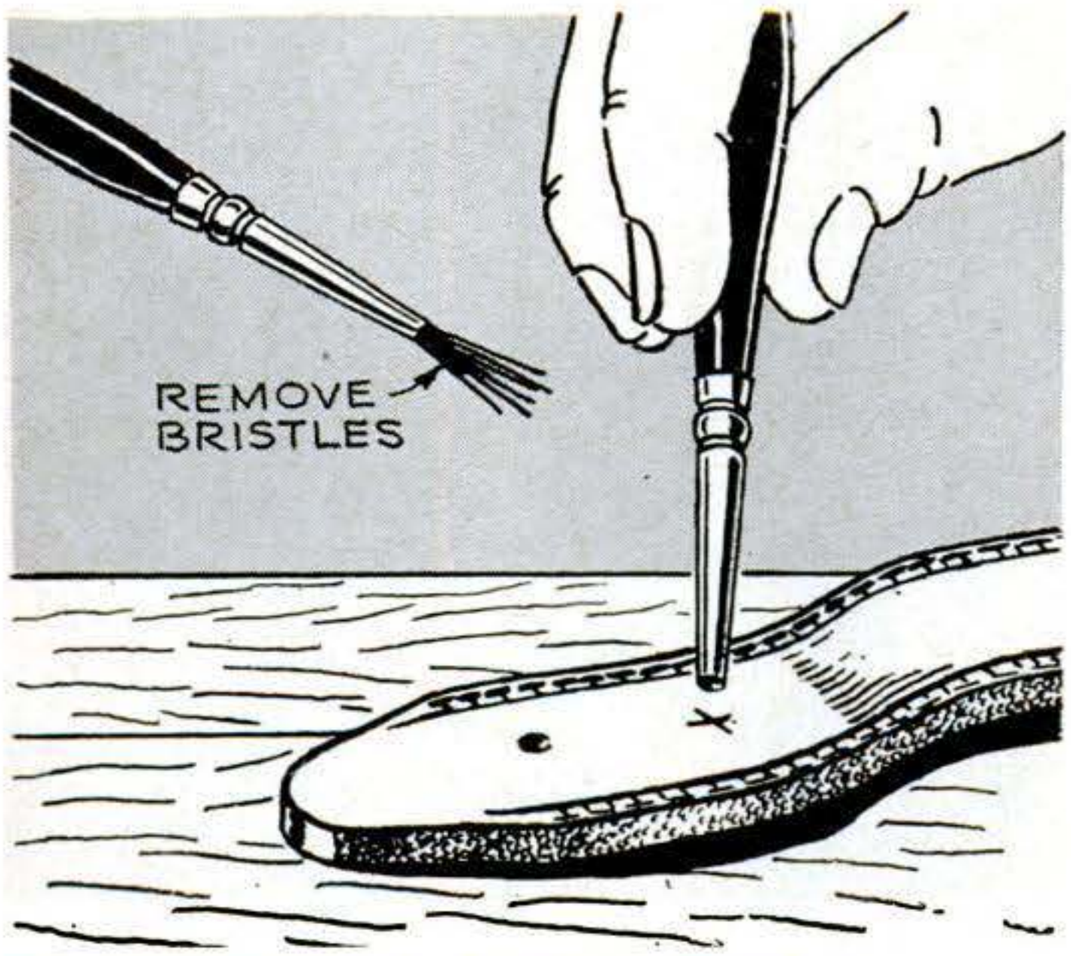
Short Cuts and Tips

FROM PS READERS

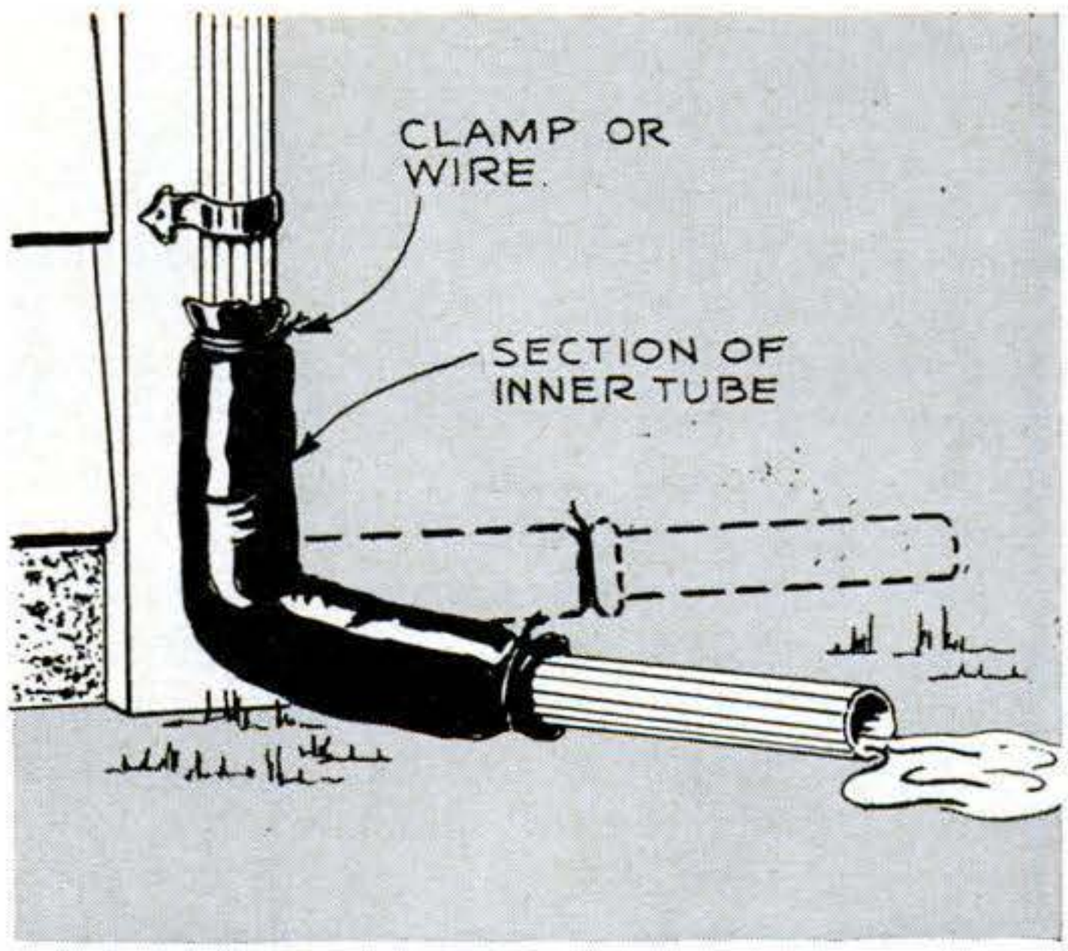
Women's Hats Perch on Doorknobs

WHAT do you do with your old doorknobs? I mount mine on dowels 6″ or 8″ long in my clothes closet to hold my wife's hats.—*R. Munstedt, Needham, Mass.*



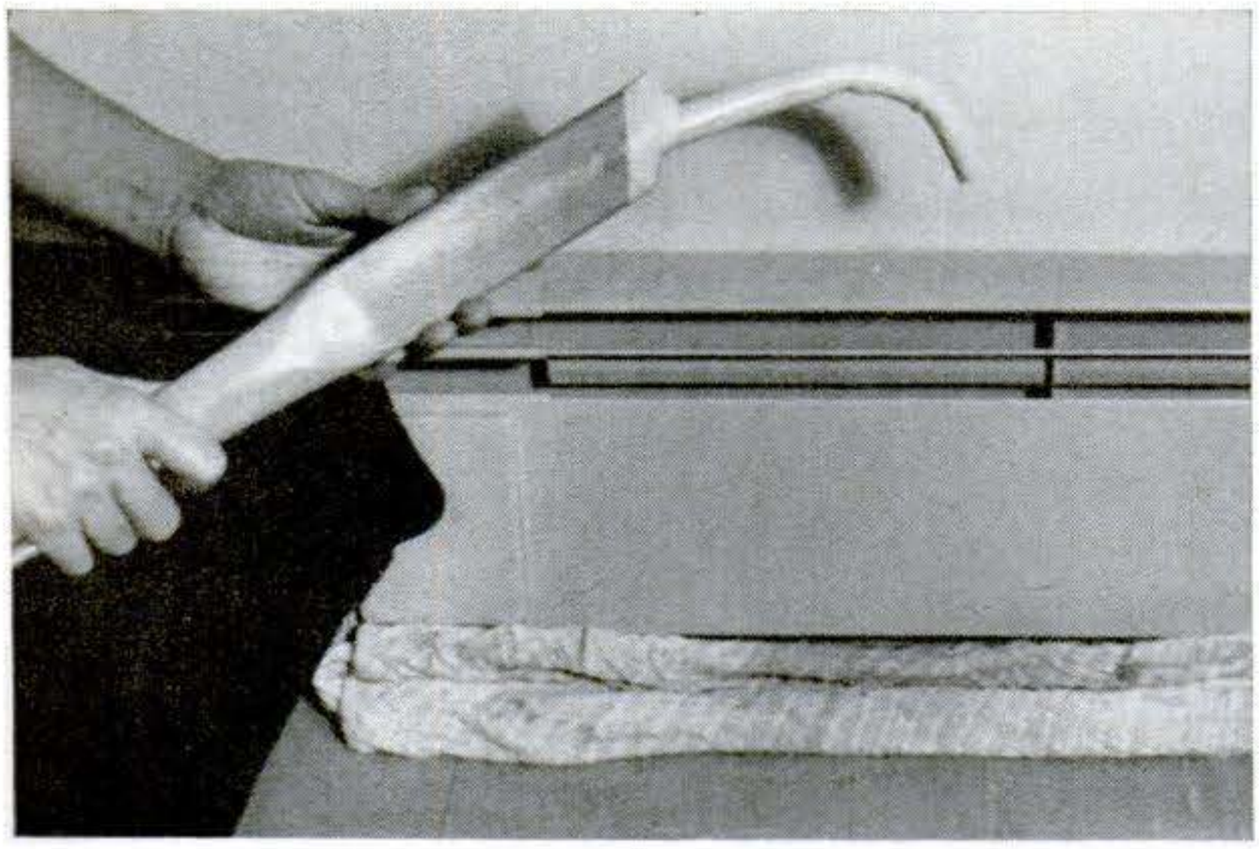
Improvised Leather Punch

THE handle of an artist's paintbrush makes a handy punch for leather or plastic. Remove the bristles from the round metal ferrule, and pick out the cement with a pin or needle. Pushed and turned through a piece of leather placed on a firm, flat surface, the tool cuts a neat hole.—*Norm Jacky, Seattle.*



Swivel Joint for Downspout

WATER won't dig holes in your lawn with this flexible downspout extension. Slip one end of a piece of inner tube over the spout, and attach a 4′ length of spout pipe to the other end. Secure the tube with clamps or wire. After each rain, move the spout in a new direction.—*Victor H. Lamoy, Upper Jay, N.Y.*



Radiator Dust Blown Out

BRUSHING out dust from between the fins of my hot-water baseboard radiators in the past has always taken a long time. Now, with the vacuum-cleaner hose reversed, I blow it out on a damp cloth placed at the bottom radiator opening. I made a special nozzle by heating and bending a piece of ¾″ plastic tubing from a hula hoop, and attached it to the cleaner's tool holder with tape.—*Robert Morris, Passaic, N.J.*

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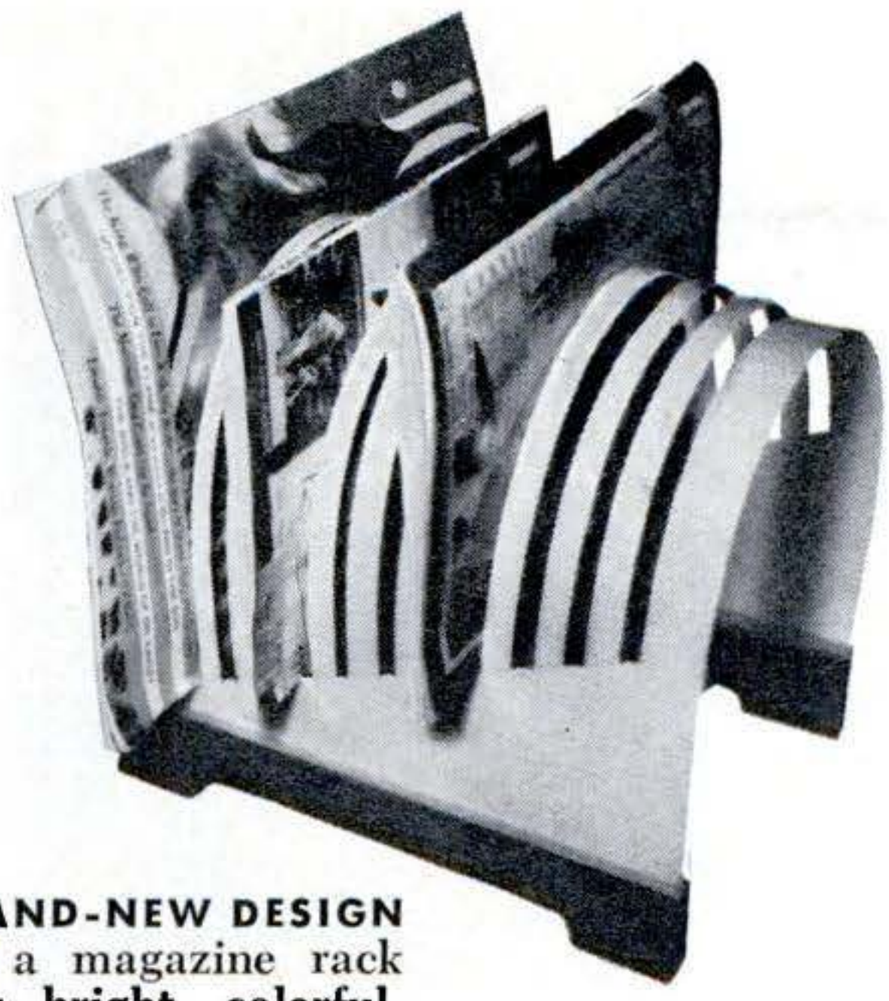
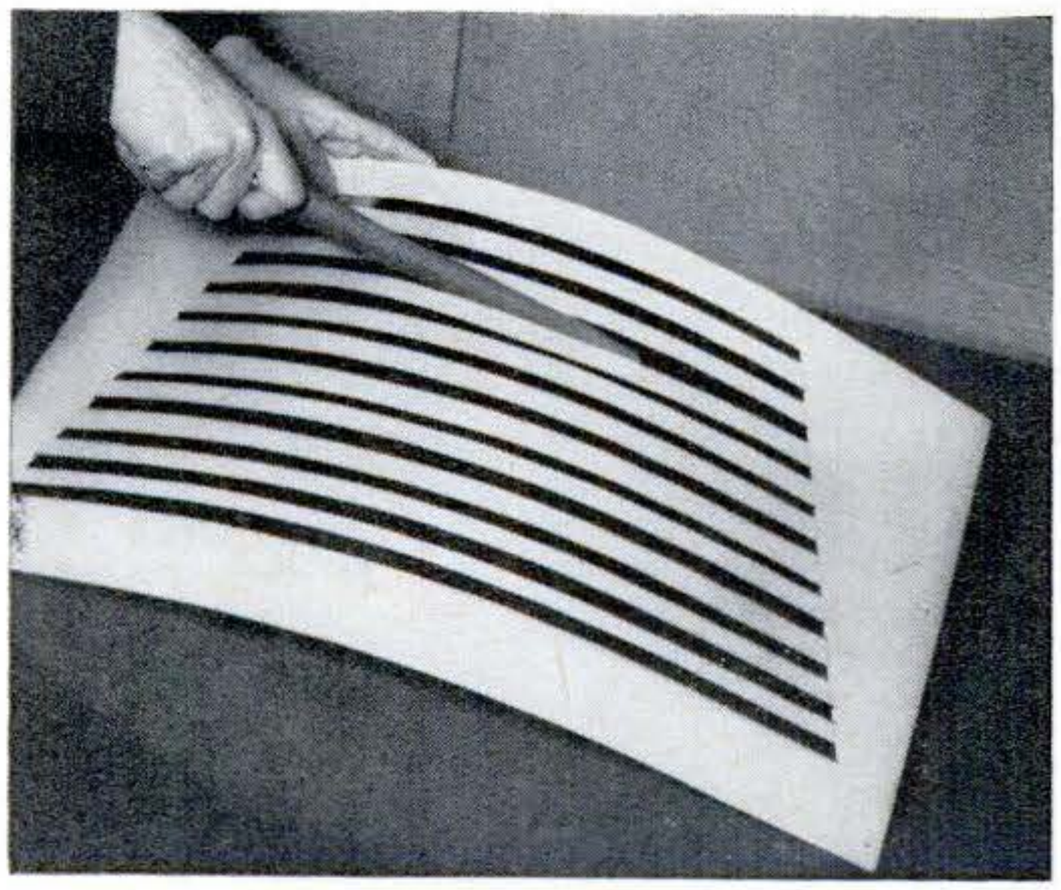
How to make

A Modern Magazine Rack



BRAND-NEW DESIGN for a magazine rack uses bright, colorful, easy-to-bend fiber-glass sheets curved like this into a U shape.



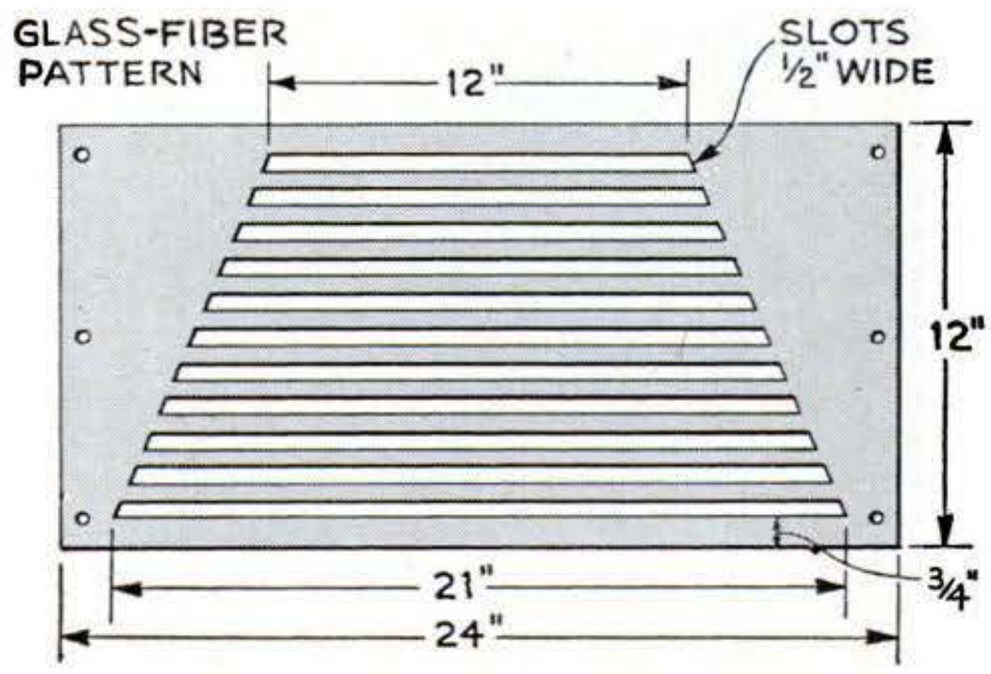
EDGES SMOOTH DOWN NICELY if you start with a fine file, then finish the job with sandpaper wrapped around a thin stick like this.

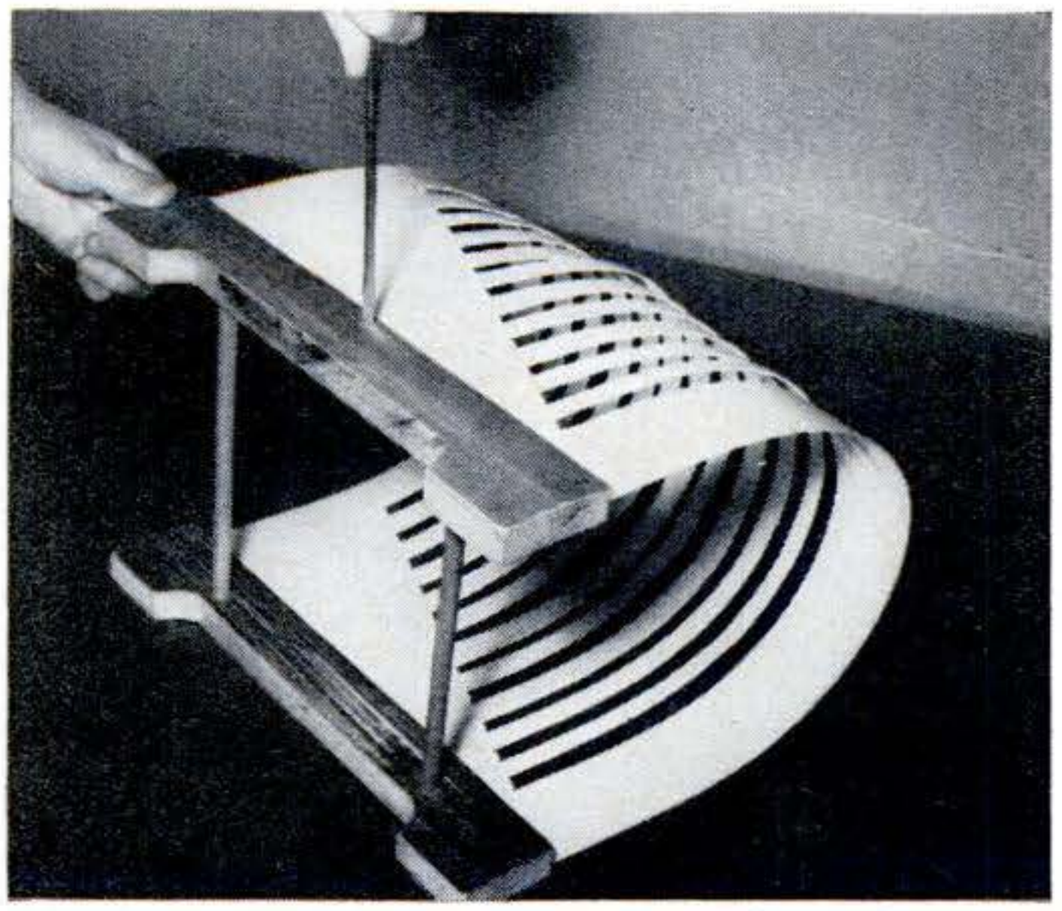
THIS modern magazine rack was made of a flexible fiber-glass sheet. It shows what you can do with a handsome, new material that's fast becoming popular for many home projects. The material comes in sheets about $\frac{1}{16}''$ thick and in many sparkling colors. It can't fade or stain, never needs finishing, and can be bent to sharp curves without breaking.

The rack was made by cutting slots of different lengths in a 12″-by-24″ sheet. When the sheet is bent to a U shape, the slots form holders for magazines of various sizes. The material used here was Filon in a milk-white shade called "Snow."

The hard surface won't take an ordinary pencil—you need a grease pencil or sharp-pointed crayon to lay out pattern lines. The slots shown here were made with an abrasive wheel in a table saw, but there are many other ways you can cut the material. A fine-tooth hacksaw blade in a frameless holder, a fine blade without set in a power jigsaw, or a fine plastic-cutting blade in an electric handsaw all work well.

Two strips of wood ¾″ thick, 2½″ high, and 12″ long form a base for the plastic. The top edge of each strip is grooved ¾″ deep on a saw blade so the fiber-glass sheet can slip into it. Fasten the material into one groove with screws, then bend it over until it slides into the opposite groove, forming the rounded rack.—*James A. Lockhart, Bryan, Ohio.*





SCREWS HOLD EDGES of fiber-glass sheet in grooved wooden base strips. The strips are held 8″ apart by ½″ dowels glued into blind holes.

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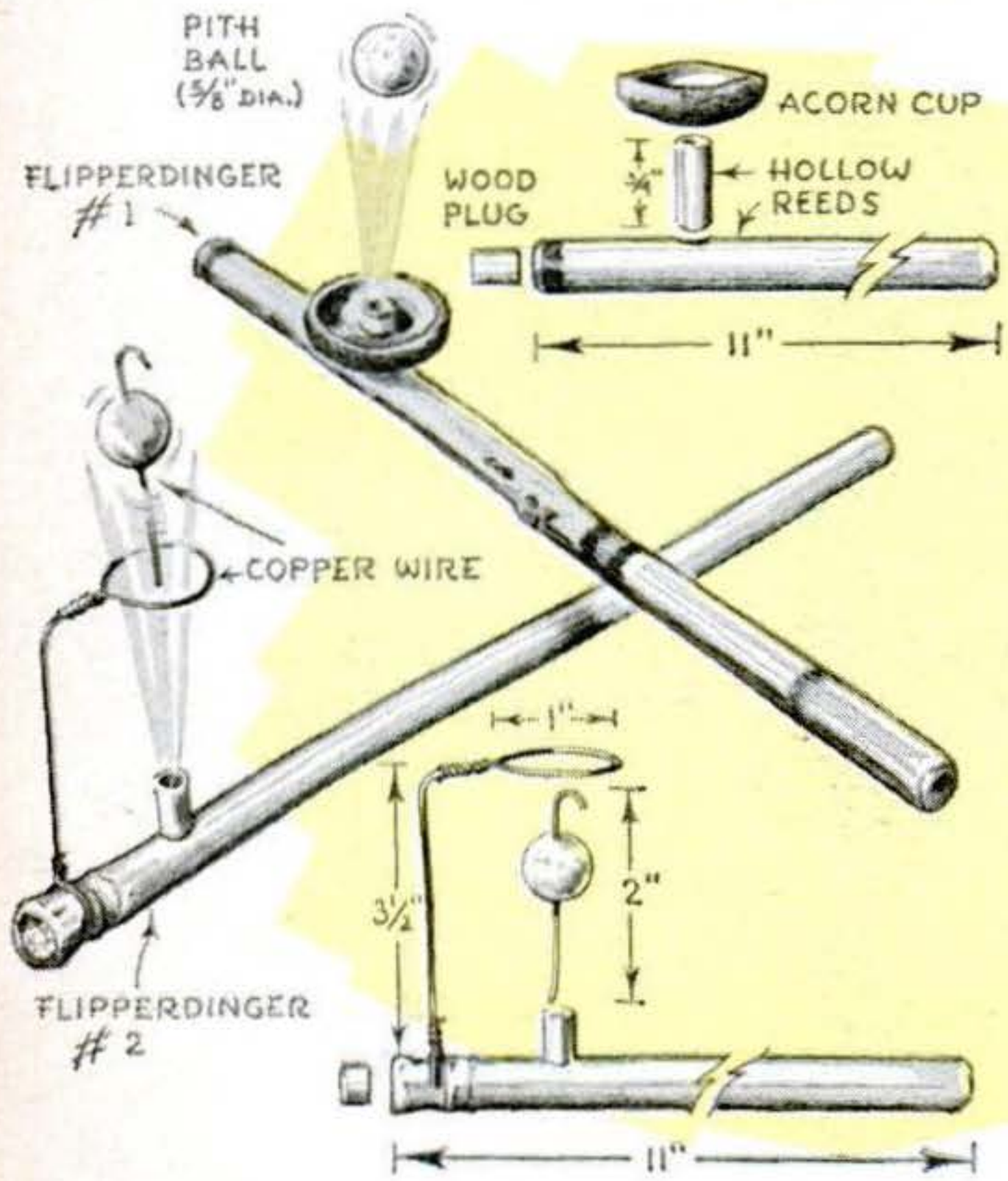
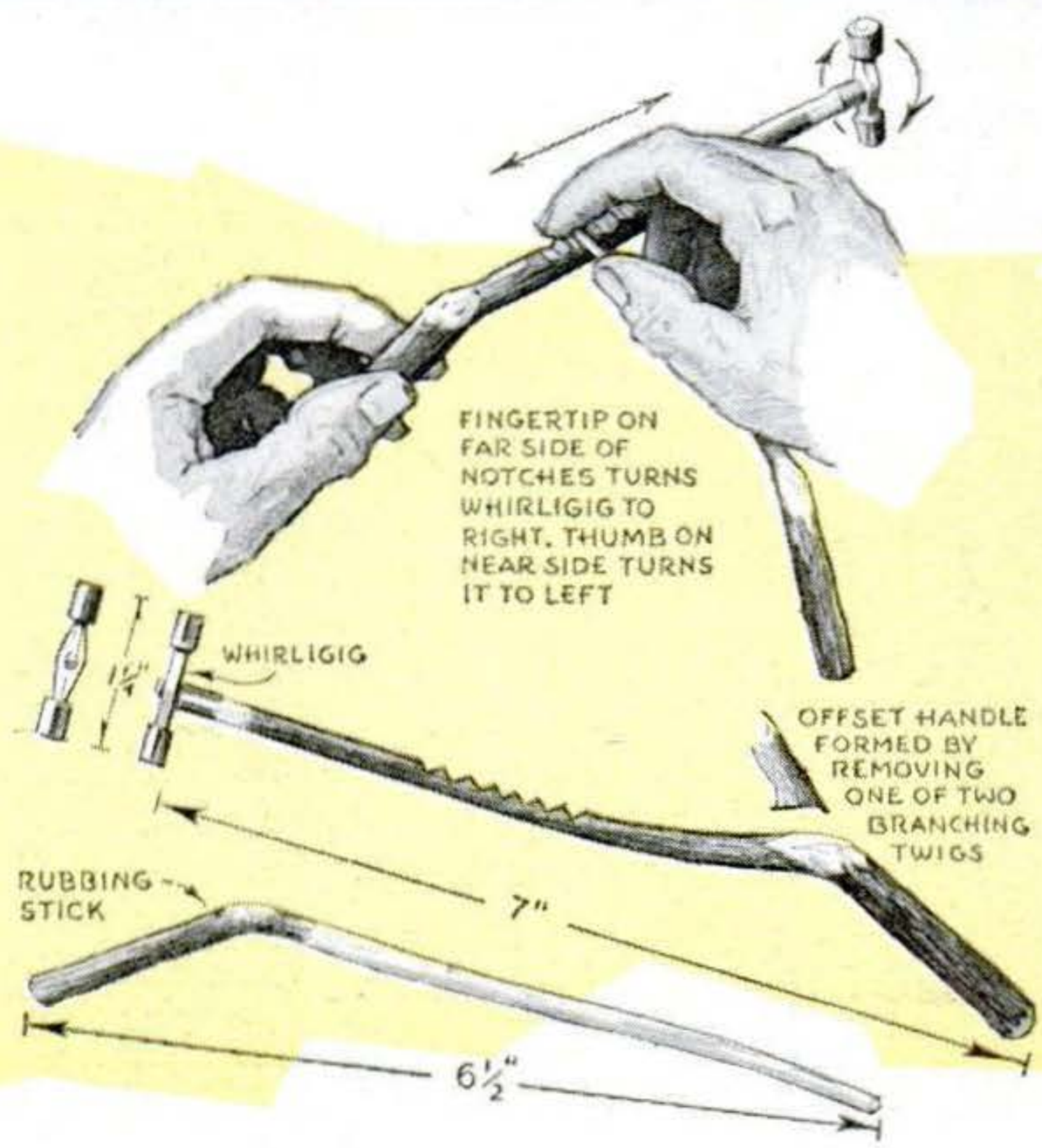
Folk Toys Are Back Again

FLIPPERDINGER





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You'll love the old flipperdingers, whimmydiddles, and their country cousins now being made in the Southern mountains

By Henry B. Comstock

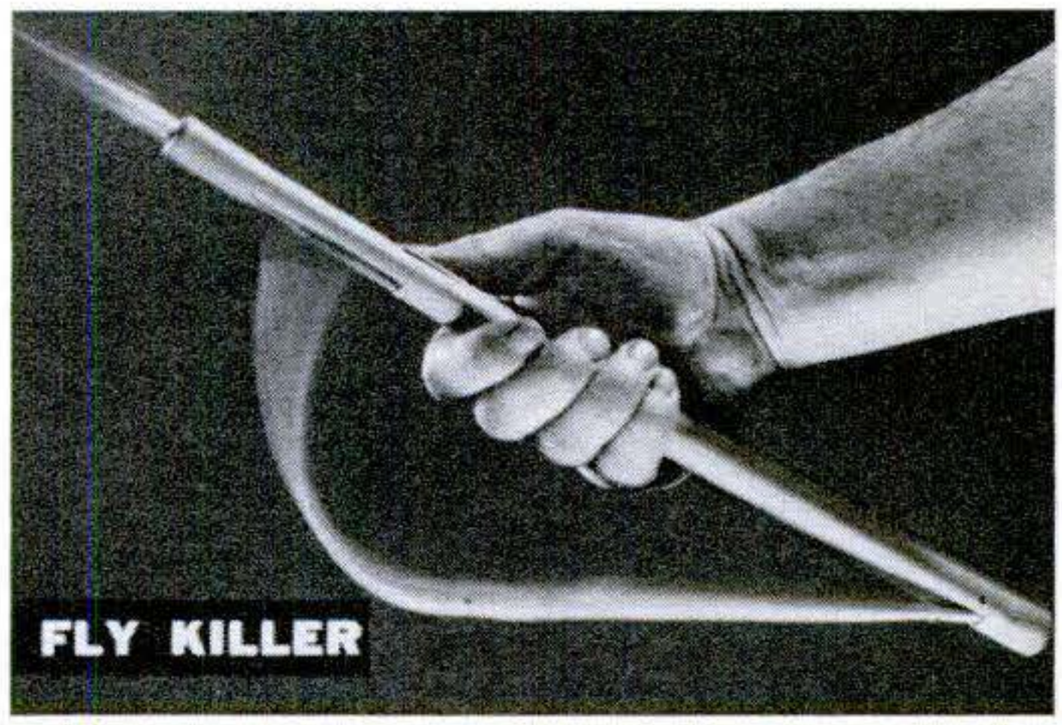
TODAY, a group of North Carolina mountain boys are busy carving a niche with their jackknives in the highly competitive toy industry. They all work in their homes around Beech Creek, a region just a whoop and a holler west of Boone, N. C. Their products are faithful copies of folk toys that have delighted children of the Southern Appalachians for two centuries or more. Wonderful gadgets are these, made of bits of laurel and rhododendron, seasoned hickory, red cedar, river cane, and acorn cups.

The idea of reviving interest in, and a market for, these folk toys came from Richard Chase, authority on the folk traditions of the Appalachian South. One day Chase wondered if there wasn't still a place for such old-time favorites as the gee-haw whimmydiddle, flipperdinger, fly killer, whizzer, and cornstalk fiddle.

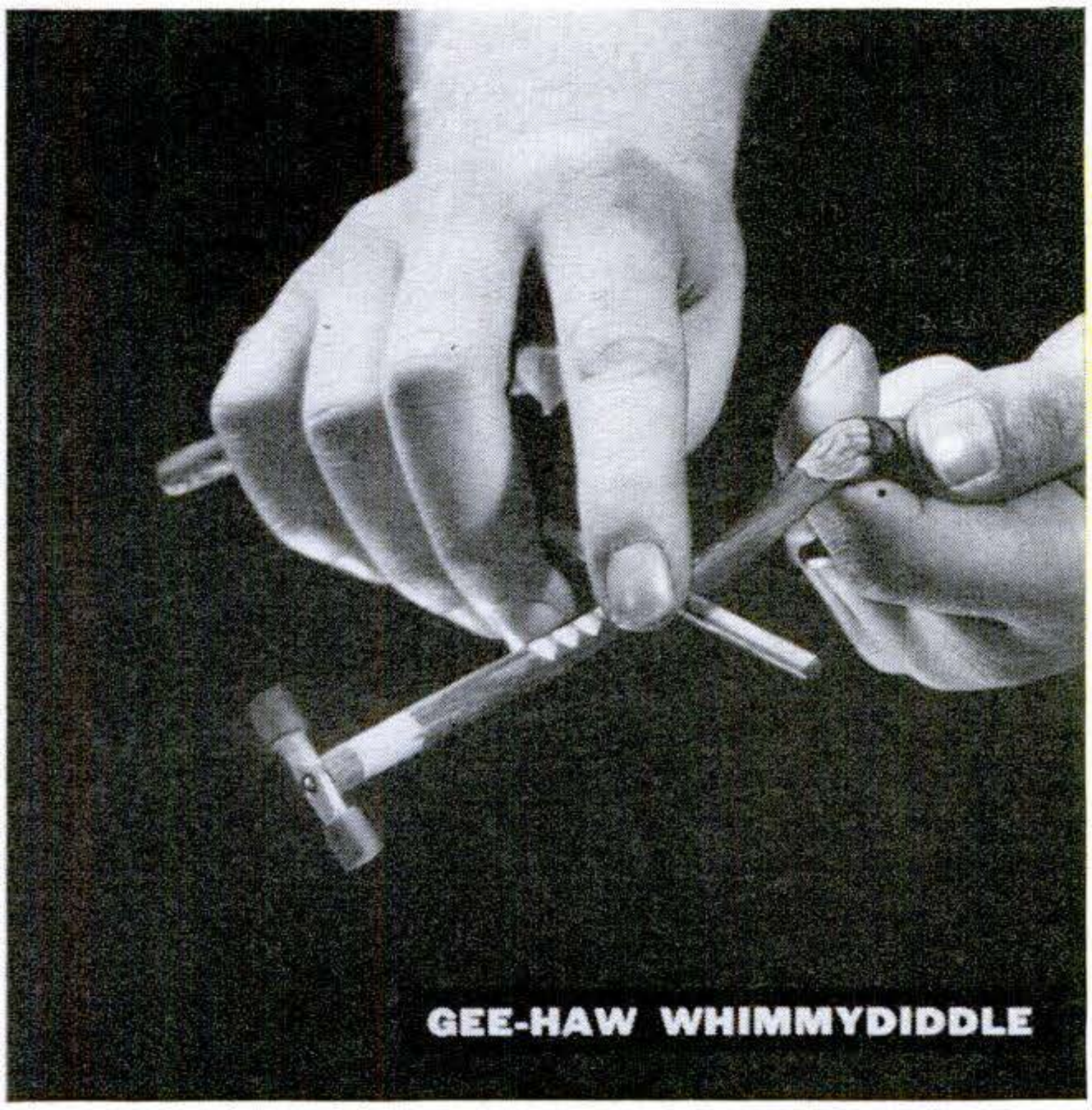
With encouragement from the Southern Highland Handicraft Guild, he talked over the idea with his nearest neighbors —Jack Guy, 31; Sam Ward, 70; Clint Harmon, 16; Dexter Stines, 16; Bill Stines, 14; Jerry Greene, 13; and the Guy and Hicks families. Could they turn out these toys in quantity, he asked, if he helped with patterns and found the outlets?

Small initial orders, placed by gift shops throughout the Asheville-Great Smoky Mountains National Park area were followed quickly by big ones. Visiting youngsters from 50 states were going for the toys like corn pone. So were their fathers. Swinging a whizzer vigorously, one red-faced tourist puffed: "They've got the wrong name on this one. Back where I come from, we used to call it a bullroarer."

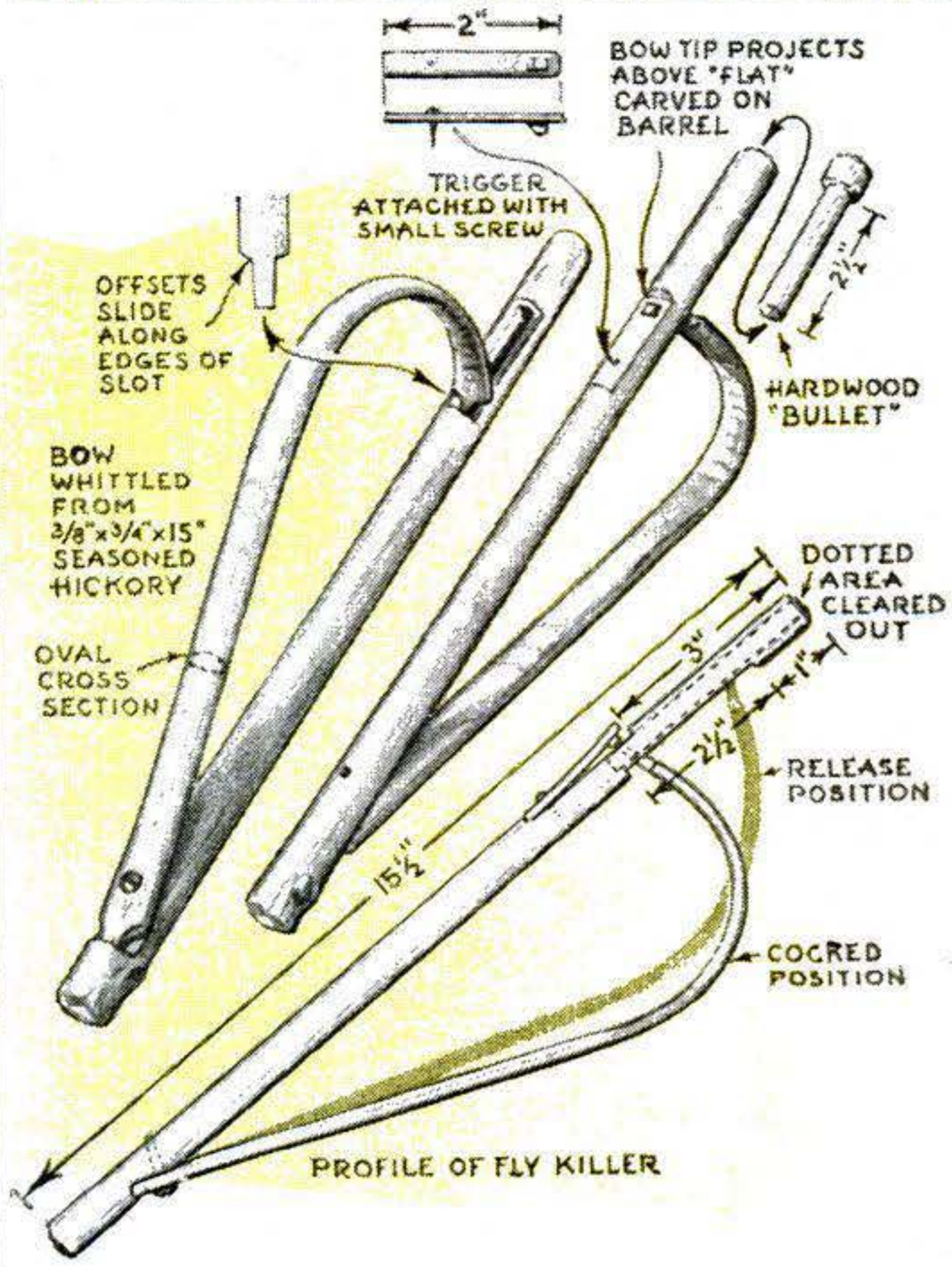
Chase knows better than to argue. A



FLY KILLER



GEE-HAW WHIMMYDIDDLE



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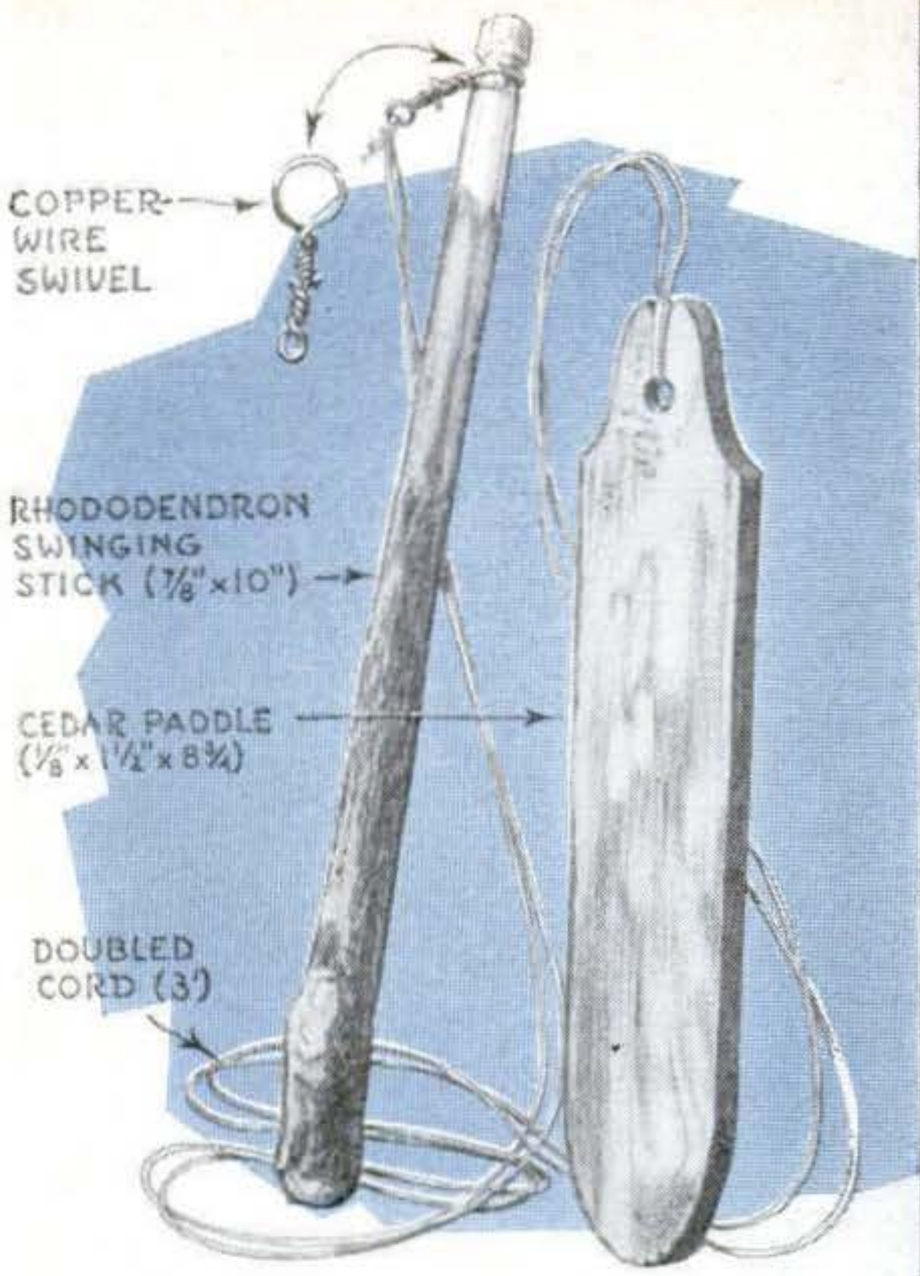

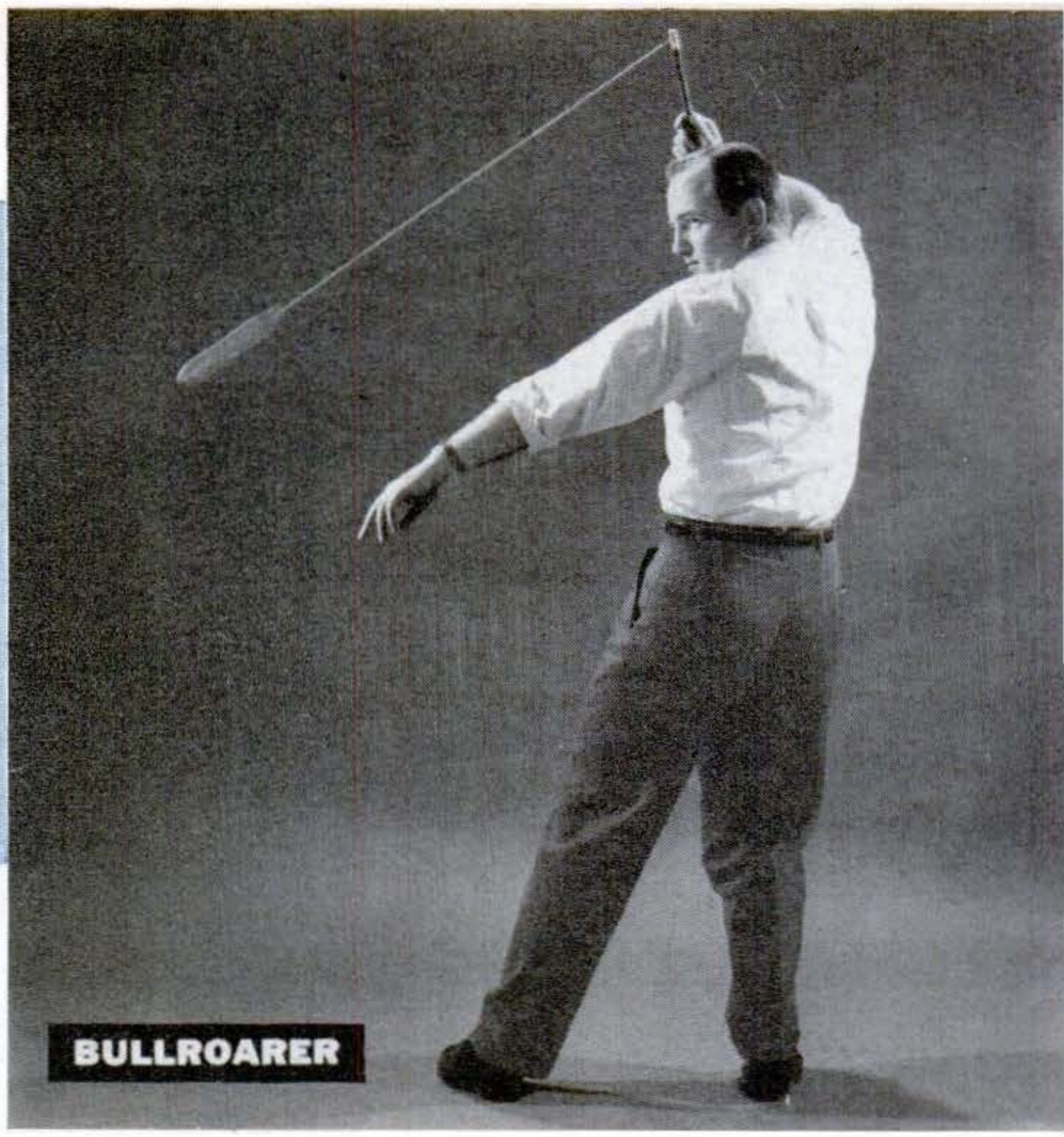

thorough researcher, he's found that none of these playthings are peculiar to the Appalachian South. The whimmydiddle, for example, has been reported from Sweden and China. And a Czechoslovakian book on early Central European toys describes many such items.

The important thing is not who invented these toys, or what they're called. It's the fact that they are bringing employment to one small Southern mountain settlement. The profits of Folk Toys Industry, Beech Creek, N. C., go into the local work of the Council of the Southern Mountains, an organization dedicated to helping rural families.

And now, just in case you don't know what a whimmydiddle is—or a flipperdinger, fly killer, bullroarer, or cornstalk fiddle—here's a rundown:

Gee-haw whimmydiddle, also called a ziggerboo (Tenn.), geehaw (Ga.), hoodoo stick (Cherokee Indians), and lie detector (Ohio). In the Folk Toys' version, it's made of rhododendron twigs, stripped to the smooth inner bark. Its two parts are a notched stick with a spinner—or whirligig—pivoted on one end, and a smaller rubbing stick.

In operating the whimmydiddle, the object is to make the whirligig spin smoothly to the right (gee), or to the left (haw), seemingly at your spoken command. To do this, you must hold both parts lightly to produce maximum vibration. This vibration is set up when you stroke the rubbing stick rapidly back and forth across the notches. If, at the same time, you let the tip of your index finger slide along the far side of the notches, the whirligig will twirl unfailingly to the right. To reverse its direction, you simply bring your thumb to bear on the near side of the notches. With a little practice, you can switch contacts so inconspicuously that anyone who doesn't know the trick will have a hard time guessing why the whirligig responds.

Flipperdinger. This is a hollow-reed blower with a plug in one end, and a nozzle, made of a smaller reed, projecting from it just behind the plug. In one model, an acorn cup with its center bored out is cemented over the nozzle. In another, a little "basketball ring" bent from copper wire is aligned with the nozzle about three inches above the tip. Both models come with a featherweight ball formed from cornstalk pith.

To work the first flipperdinger, you

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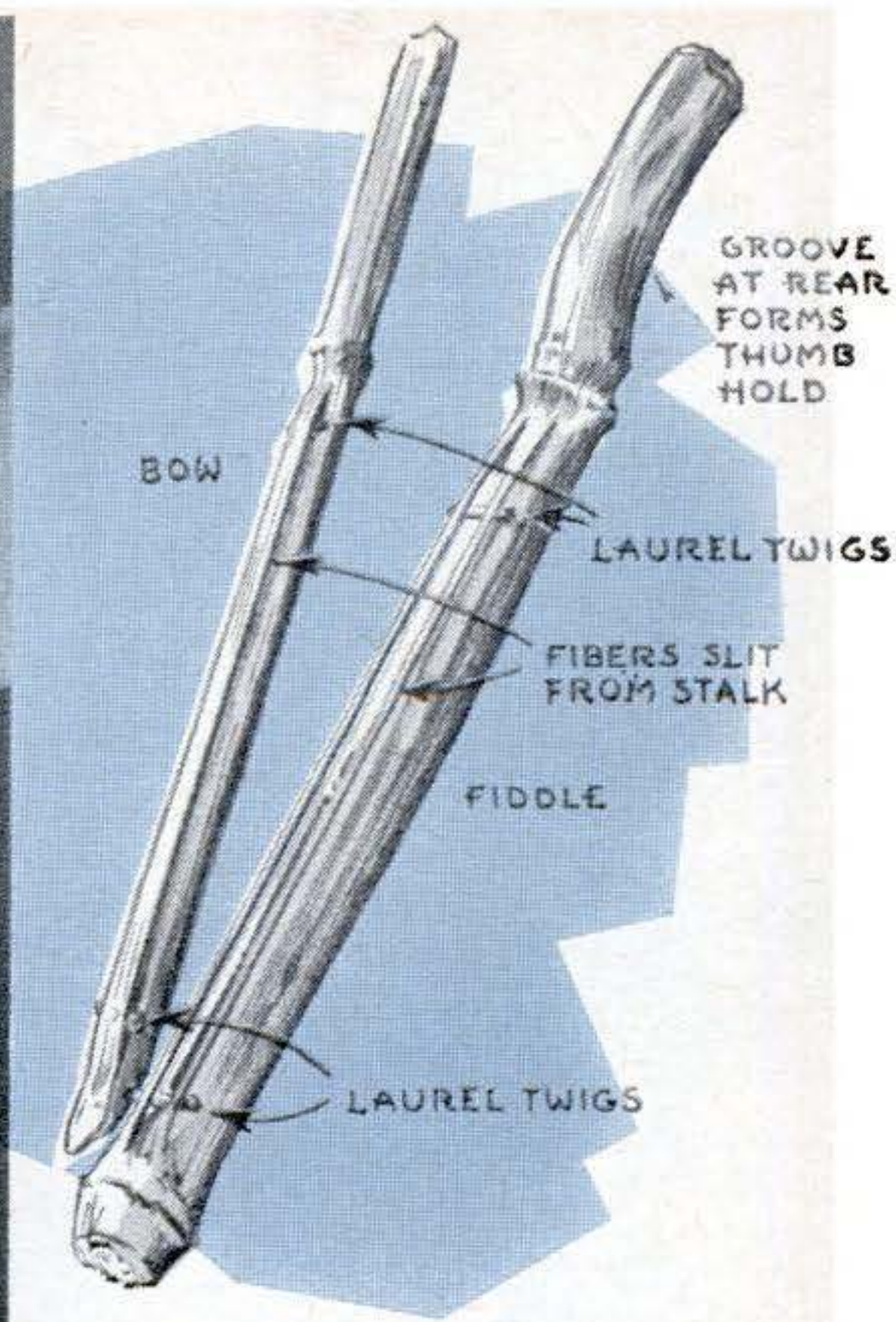
CORNSTALK FIDDLE



place the pith ball in the acorn cup and blow lightly but steadily into the open end of the larger reed. When done right, the ball rises slowly in a jet stream of air, hovers a few inches above the nozzle, and then as you ease off, settles back.

The other flipperdinger is harder to master. Here the pith ball has a wire thrust through it—one with a crook in one end. You hang the crook over the basketball ring. Then, with plenty of well-controlled lung power, you can unhook the ball, lower it through the ring, and, finally, blow it back up again and replace the crook on the wire.

Fly killer. This potent and fairly accurate little weapon could almost be called a one-armed crossbow. It has a barrel made of a short elderberry stick with its forward end hollowed out, and a long slot cut through its side wall and into this cavity. Near the back of the barrel a strip of seasoned hickory is fastened in an angled notch with a wood screw. The other end of the hickory strip is slimmed down and bent in a permanent bow by soaking. In cocked position, the pointed tip of the bow is placed in the slot and drawn back until it enters a hole in the opposite side of the barrel. This depresses a trigger made from a sliver of springy wood.

To load the fly killer, you slip a flat-headed wood shaft into it. Pressing the trigger pops the bow tip out of the hole and sends it flying forward in the slot, snapping the missile out with enough force to shatter a window at 10 paces.

Bullroarer. Simplest of the toys, the bullroarer (whizzer) is a thin cedar paddle attached to a rhododendron handle with a doubled length of stout cord. When it's swung in circles through the air, it makes an awesome, buzzing sound. A copper-wire swivel on the handle prevents the cord from winding around the wood.

Cornstalk fiddle. Not even a tone-deaf Cherokee could confuse this with a Stradivarius. But for caterwauls that would make a mountain lion lift his eyebrows, you can't beat a two-string cornstalk fiddle. Instrument and bow have strips of their bark slit in such a way that, with "bridges" formed of twigs inserted beneath them, they become tensioned bow and fiddle strings. Properly rosined before it leaves the Folk Toys Industry workshop, a cornstalk fiddle is good for months of ear-piercing screeches.

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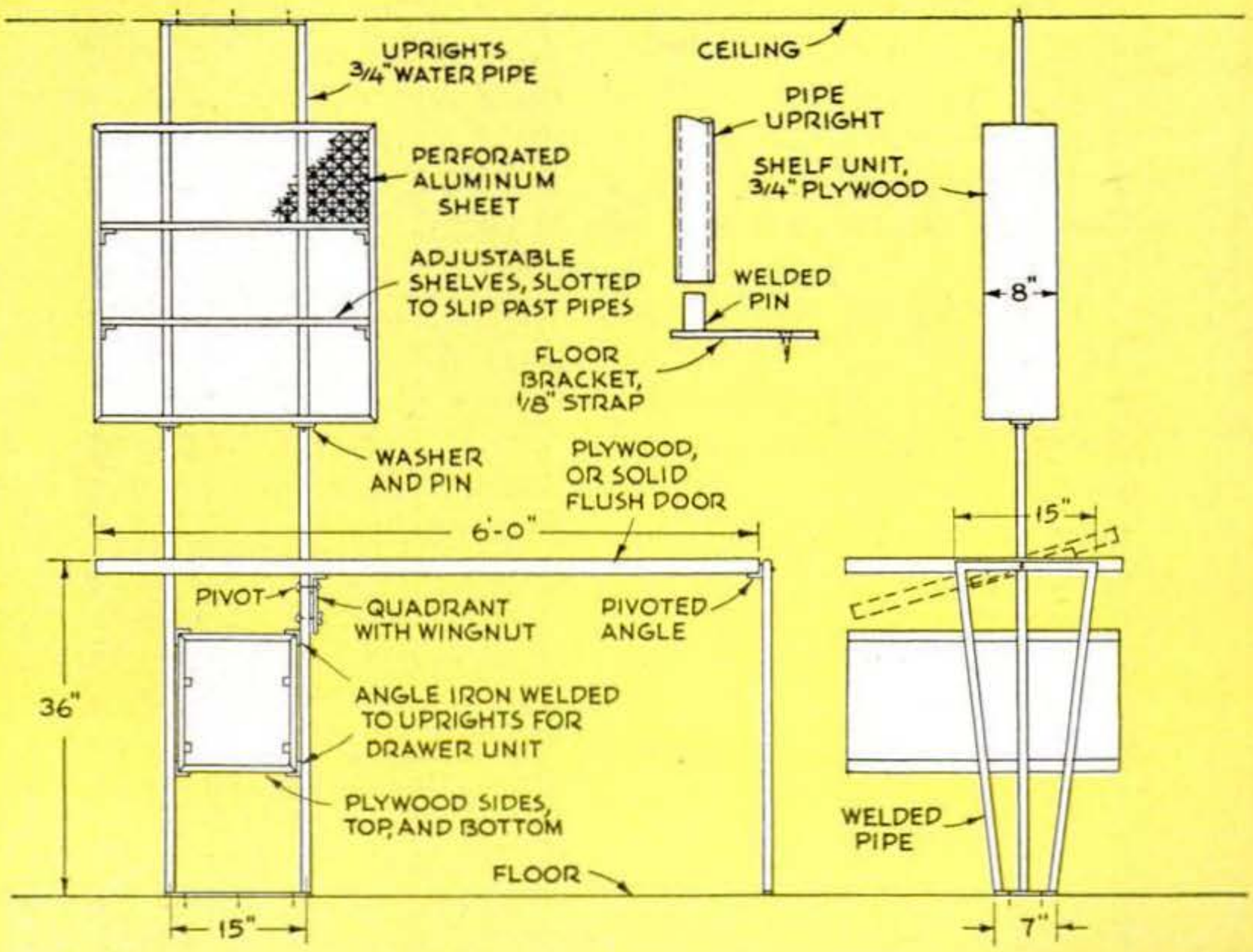
TILTED UP, the table becomes a handy flat surface for quick reading and note-taking. This one is made 36" high for convenient stand-up use; for sitting down, it can be made lower—28" to 30" high.

TILTED DOWN, convertible desk provides a sloping drawing surface adjustable to any angle. Pipes pass through elongated holes, which permit the desk to tilt. Note the sheet of perforated aluminum tacked to the back of the bookshelf for a striking decorative pattern. Stool is bent and welded from ½" mild-steel rod, topped with a plastic-upholstered seat.

TWIN PIPE UPRIGHTS support entire unit except for outboard end of desk, which rests on hairpin leg. Semicircular plate permits tilting bracket to lock at any angle. Assembly, being checked here for fit, slips into pins in floor cleat, is then swung up and screwed to ceiling. Before final installation, table and shelves must be in place.



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HOW TO BUILD A Drawing Desk in Modern Style

By John Burroughs

EVER wish you had a drawing board for working on projects, yet wondered where the space was coming from? This smartly styled modern unit gives you a conventional desk and a tilt-top drawing board in a single unit. And it includes a bookshelf and two-drawer storage cabinet within arm's reach of the desk area.

Everything hangs from common ¾″ black-iron pipe, which gives the unit a slim appearance and—as bonuses—cuts costs and eliminates complicated carpentry. The desk shown is 6′ long, but it can be made to suit any space you have. The only special skill required is welding, and you can have this done at a local shop if you wish.

Two parallel upright pipes support the bookshelf, drawers, and one end of the table top. The other end of the desk rests on a single hairpin-shaped leg, also welded from ¾″ pipe. Angle-iron brackets pivoted to one upright pipe and to the hairpin leg permit the desk to tilt between them. The bracket that pivots on the upright pipe is fitted with a semicircular quadrant cut from ⅛″ steel plate. A bolt through the quadrant and wing-nut permit the desk to be locked at any angle.

The two upright pipes are held by metal cleats that have pins welded to them to slip into the ends of the pipes. The cleats are then screwed to the floor and the ceiling to hold the pipes securely in place.

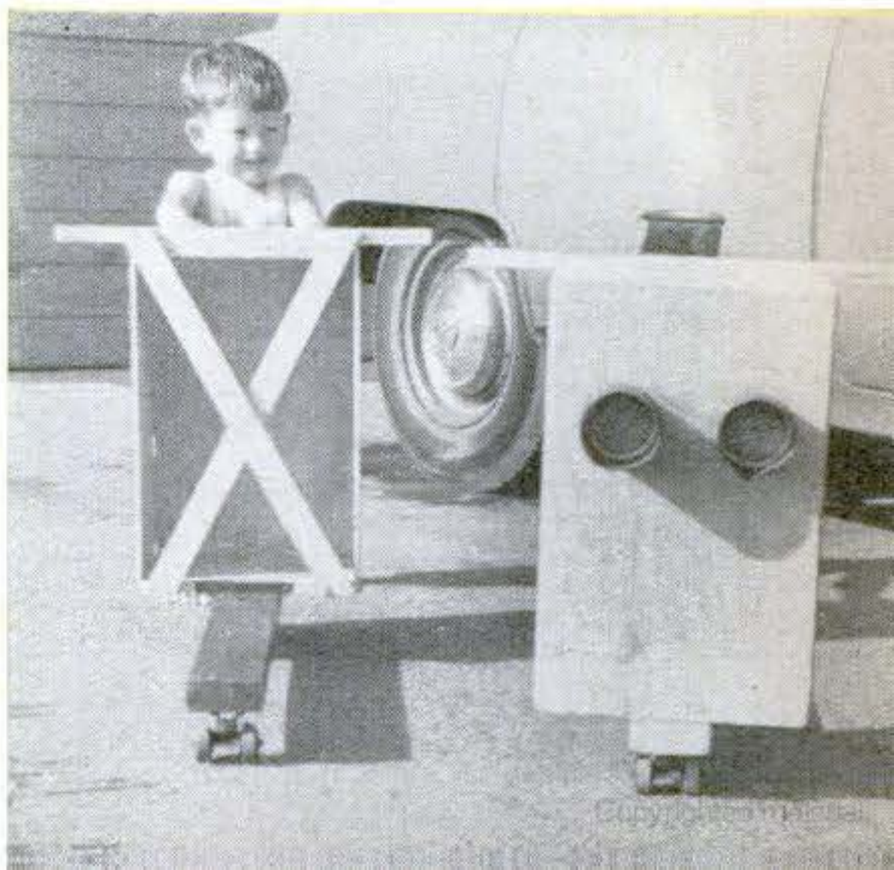
The table top can be either plywood or a solid slab door. The door is more expensive but also more solid, especially for a long desk. Bore the table and boxlike bookshelf section so they slip over the pipe uprights. Rasping the holes in the table to a tapering slot will allow the top to pivot around the pipes.

The bookshelf rests on large washers slipped over the pipes and held by cross pins through the pipes. Lengths of steel angle welded to the pipes below the table support the drawer unit.

A Scooter Like Pop Used to Make . . . and Still Does

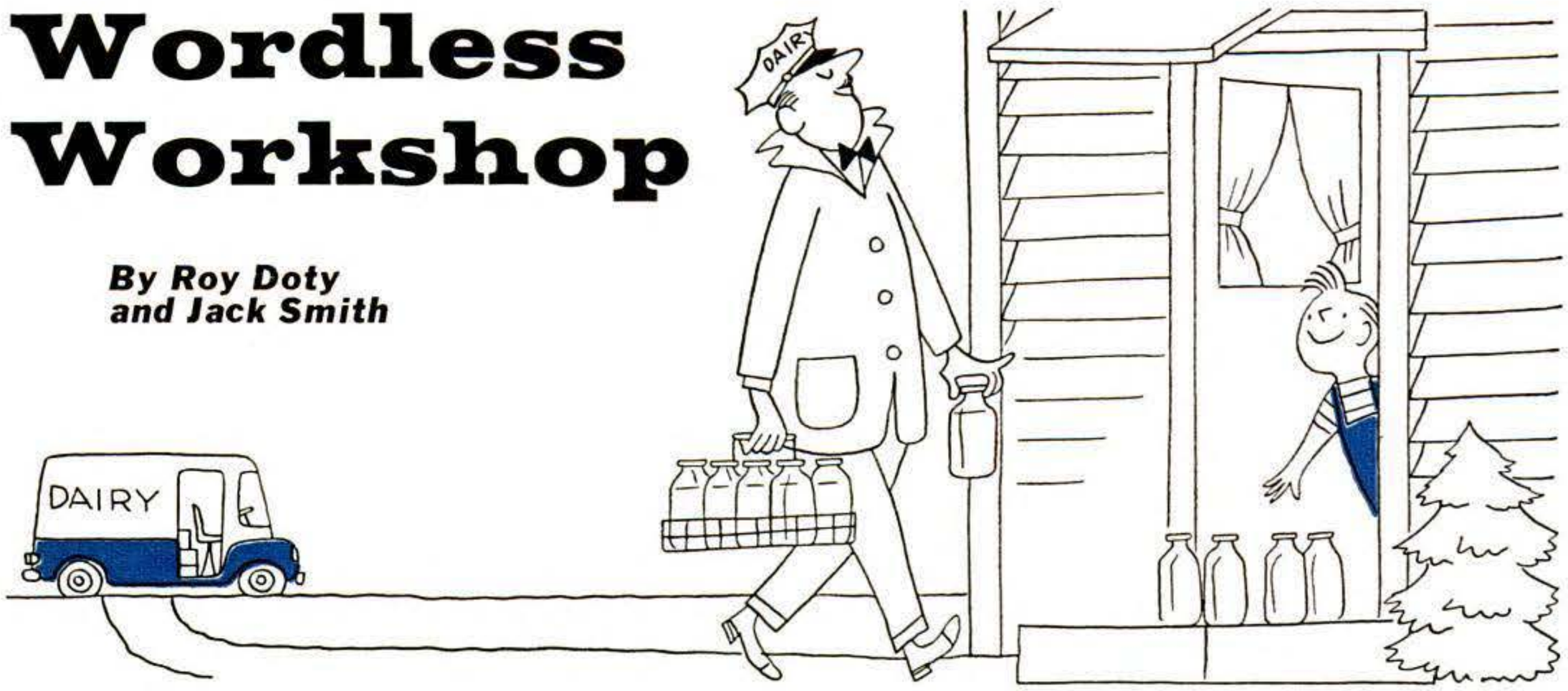
Look, Pop, here I go. Those old roller skates sure came in handy for these wheels. That two-by-four I'm standing on is 36″ long. The apple box came from the grocery store. Those are tin cans nailed on the front for headlights. Pop says this skater scooter is just like the one he made when he was a kid. I'm two years old.

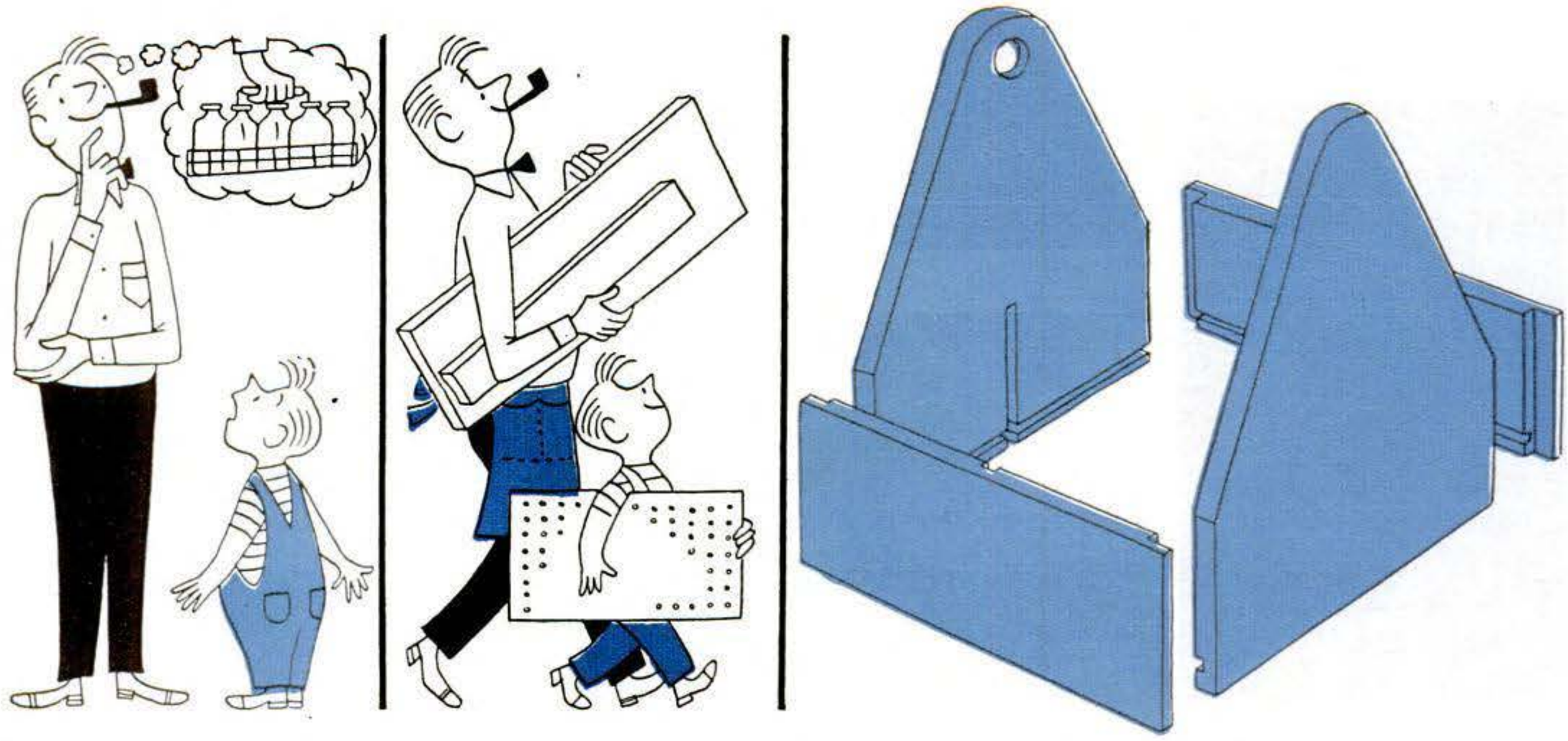
That other scooter is for my big brother—he had to have one, too. The only tricky part, Pop says, is hacksawing the backs off the skates and screwing one half to each end of the base. Bracing the box is important, Pop says, because—well, I guess I'm a little rough on things. Who's my Pop? He's Robert B. Ryan, Torrance, Cal.

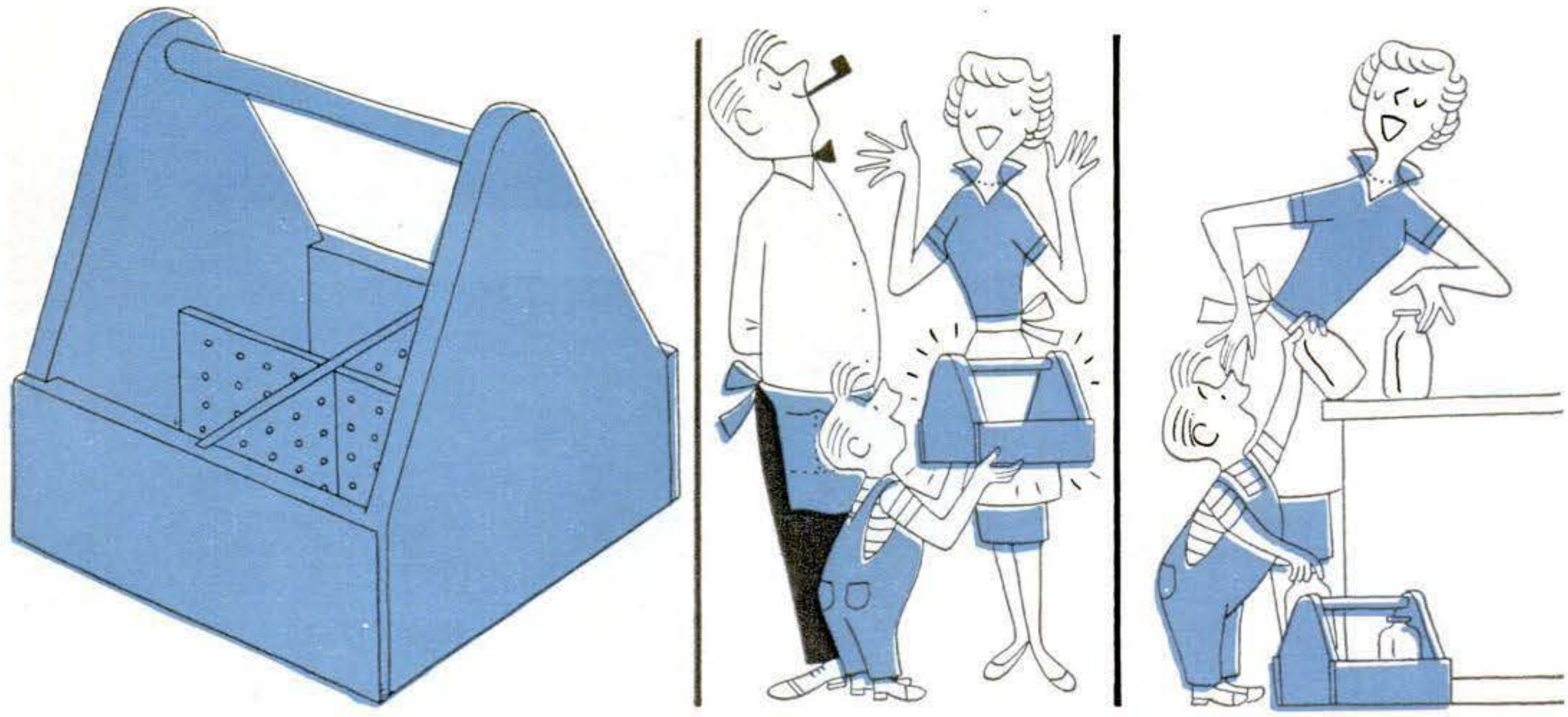


Wordless Workshop

By Roy Doty and Jack Smith







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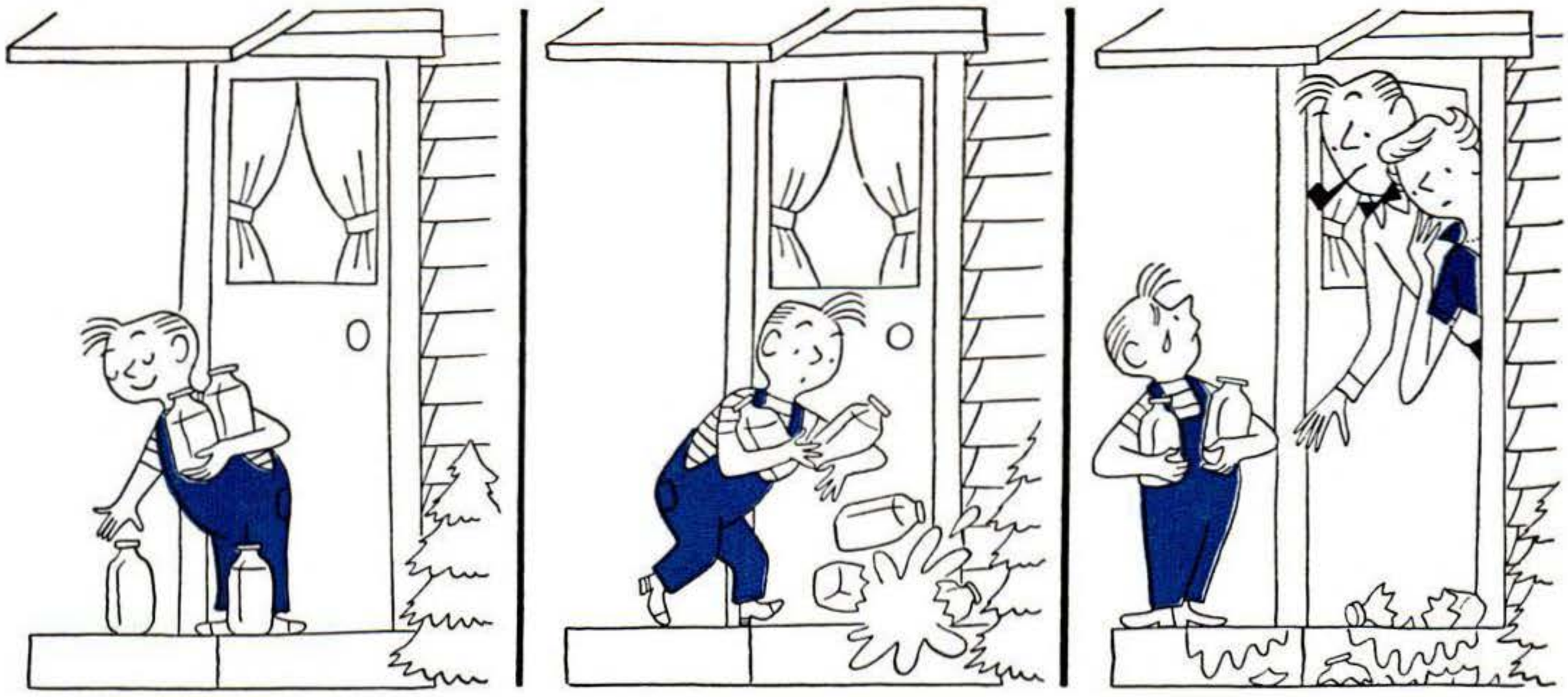

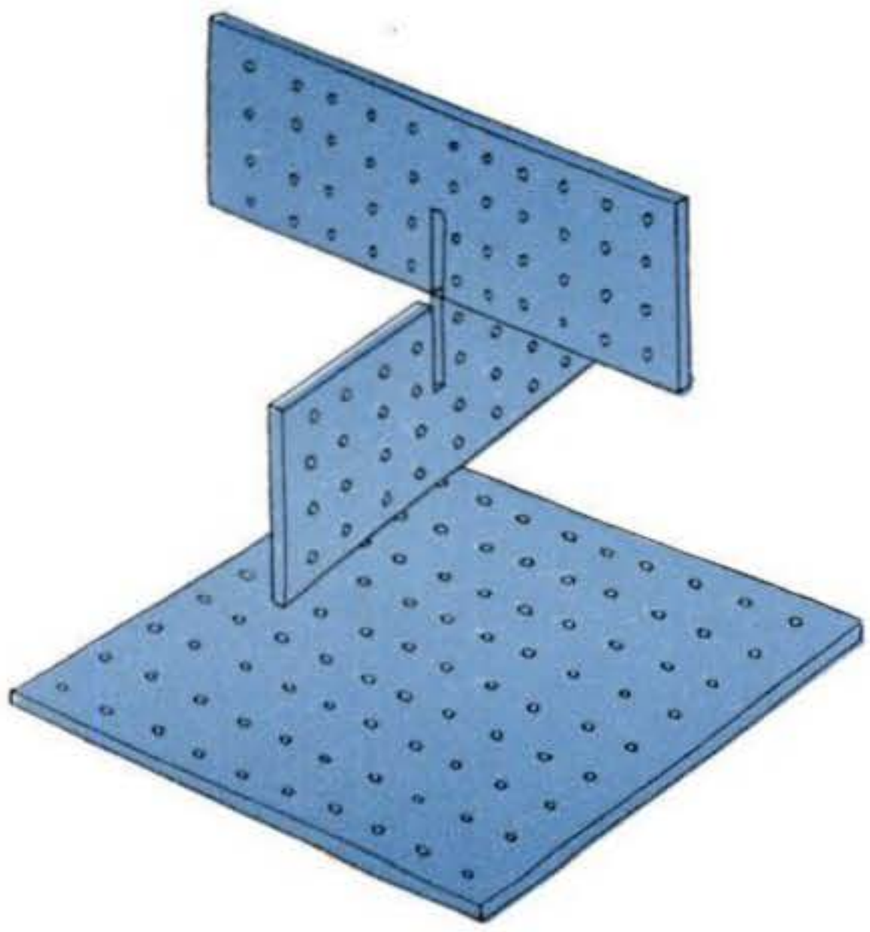

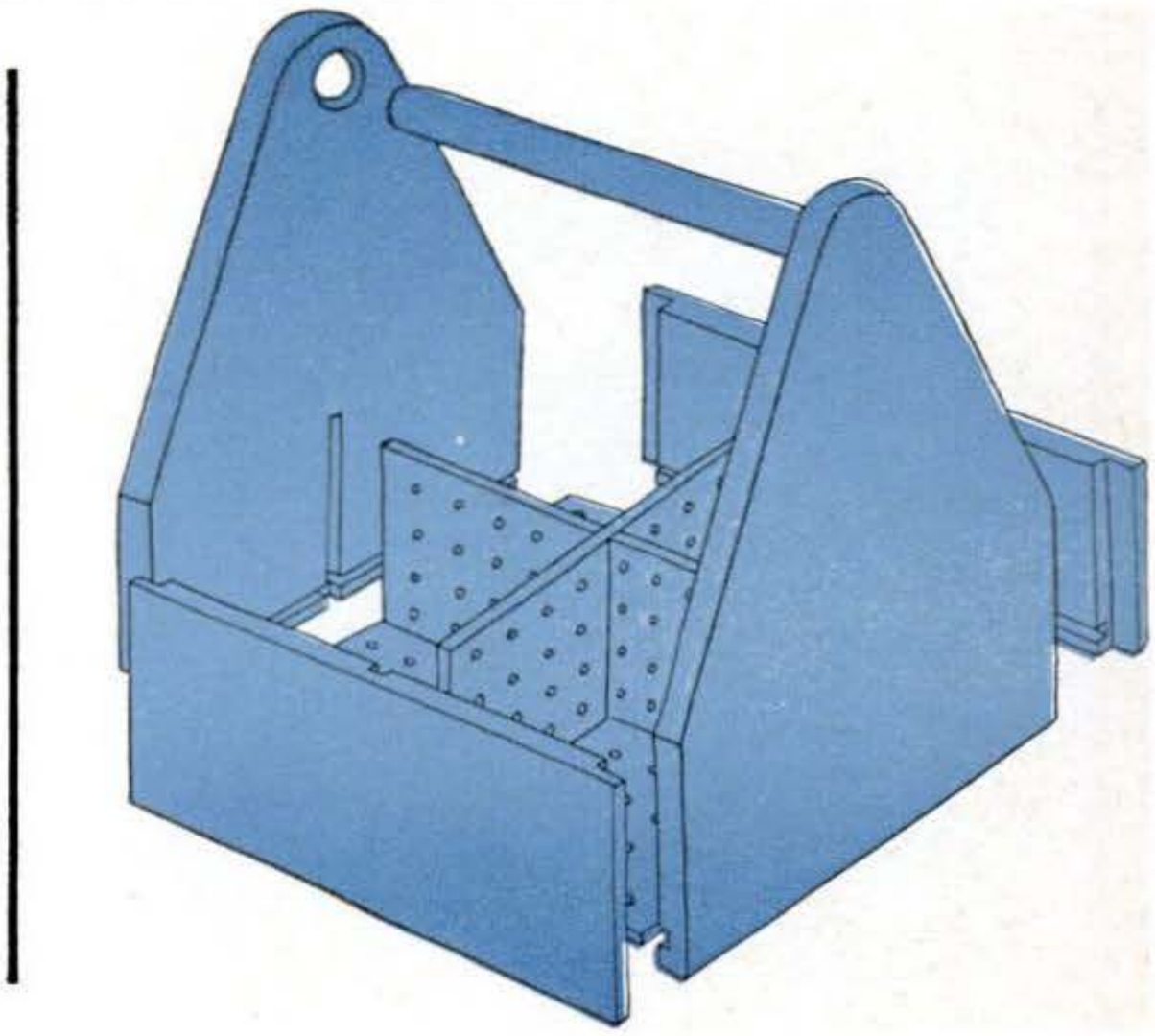

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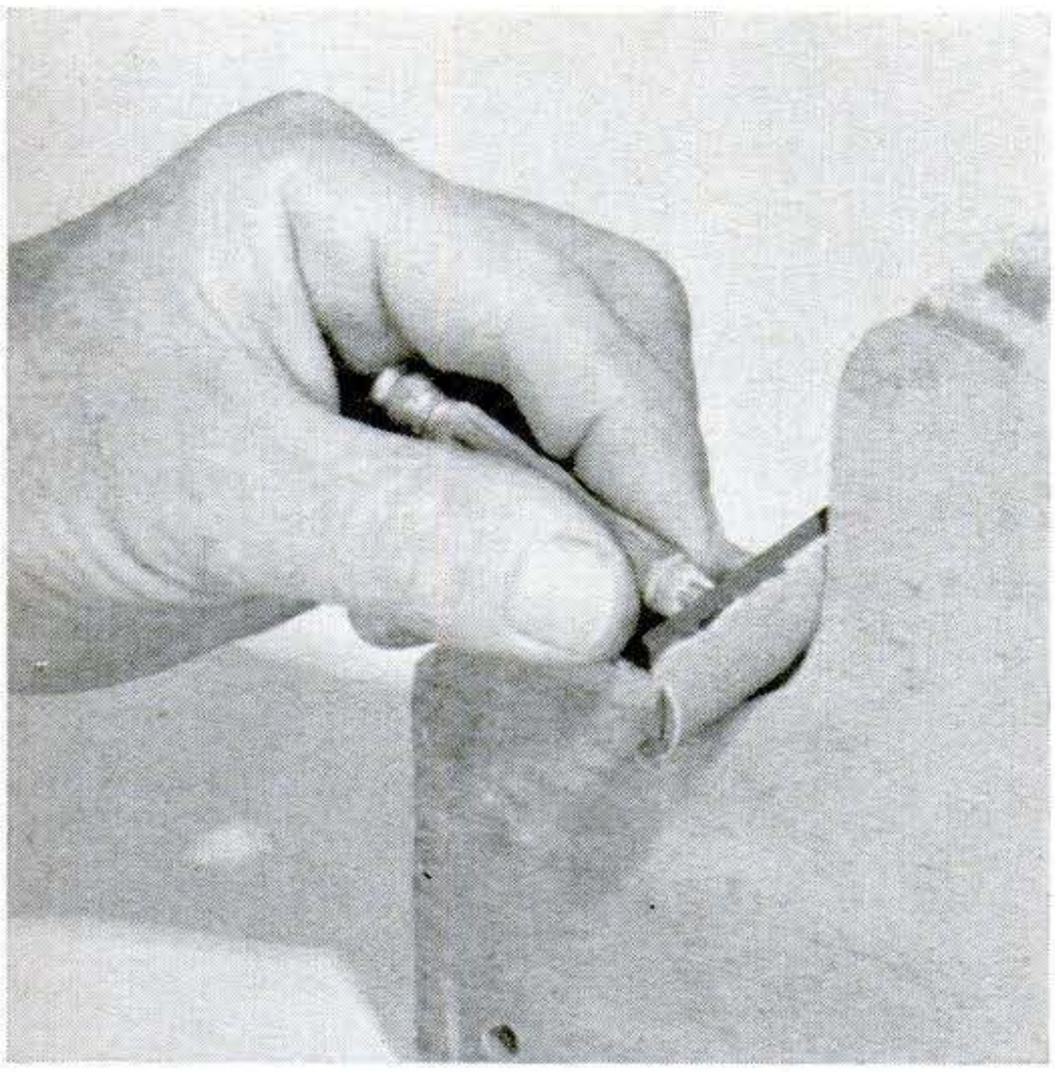
Short Cuts and Tips

FROM PS READERS

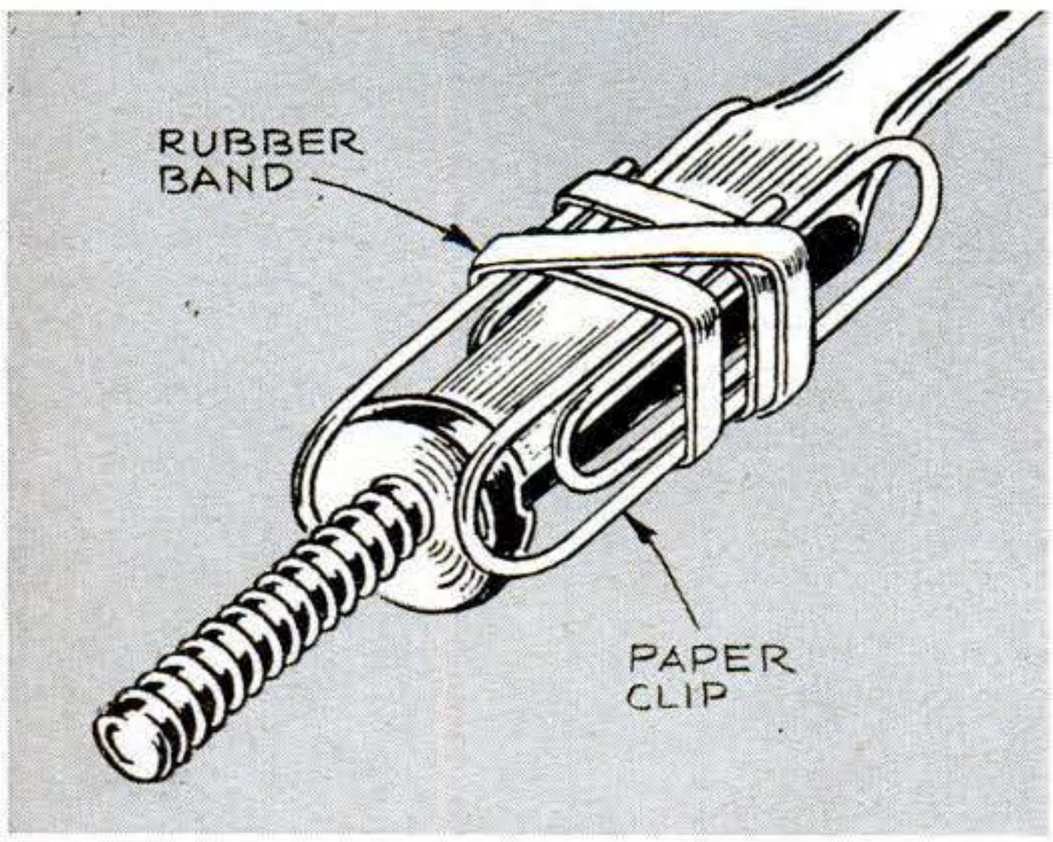


Razor as a Sanding Tool

FIT a piece of sandpaper over the head of an old safety razor and you have a handy tool for sanding small and irregular concave edges. Tuck the sandpaper ends in where the blade usually goes.—*W. H. McClay, Pasadena, Cal.*

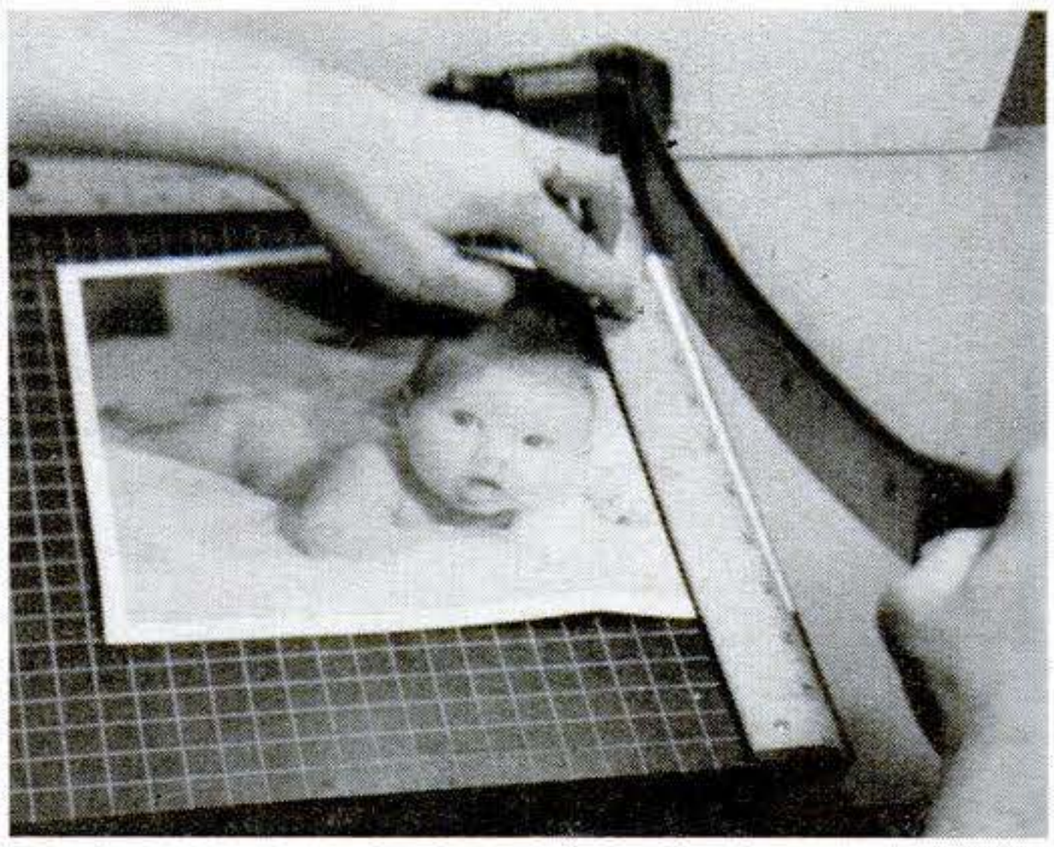
Shelves from Trunk Tray

THERE'S new life in that old attic- or basement-stored trunk—if the tray is in good condition. Fastened to a wall and painted, the tray makes an attractive whatnot cabinet, as you can see in this sketch.—*Robert Lamont, Albany, N. Y.*



Paper Clips Start Screws

YOU can start screws easier in hard-to-reach places by clamping them to the driver. Improvise a clamp by stretching a rubber band around two paper clips and the driver bit. Place the screwhead between the paper clips; it will stay until the driver is twisted away.—*Glen F. Stillwell, Manhattan Beach, Cal.*



Clamp for Photo Trim Board

A PHOTO print that has dried unevenly or curled up can be hard to trim to an even border in the familiar trimmer. An old wood ruler, shimmed at each end to the thickness of the print, and then screwed to your trimming board will hold the print flat and keep it free of fingerprints.—*Robert Micals, Freehold, N.J.*

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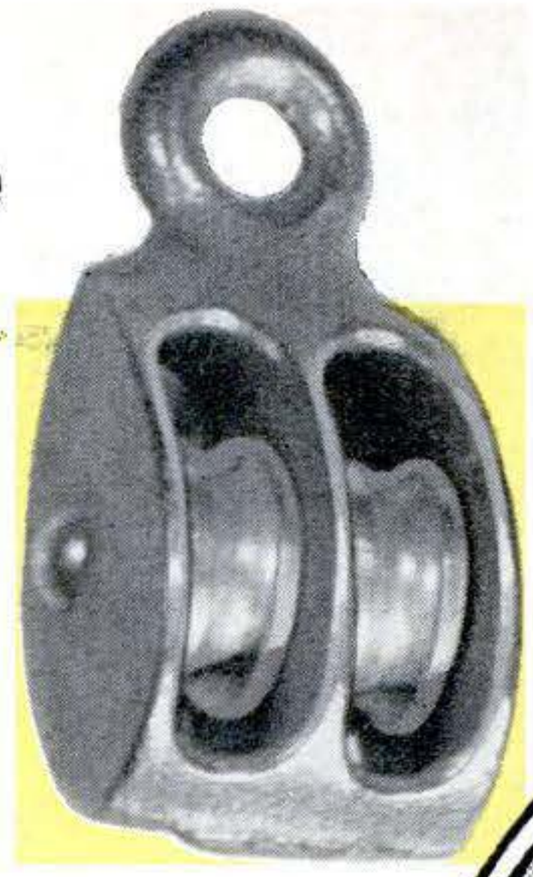
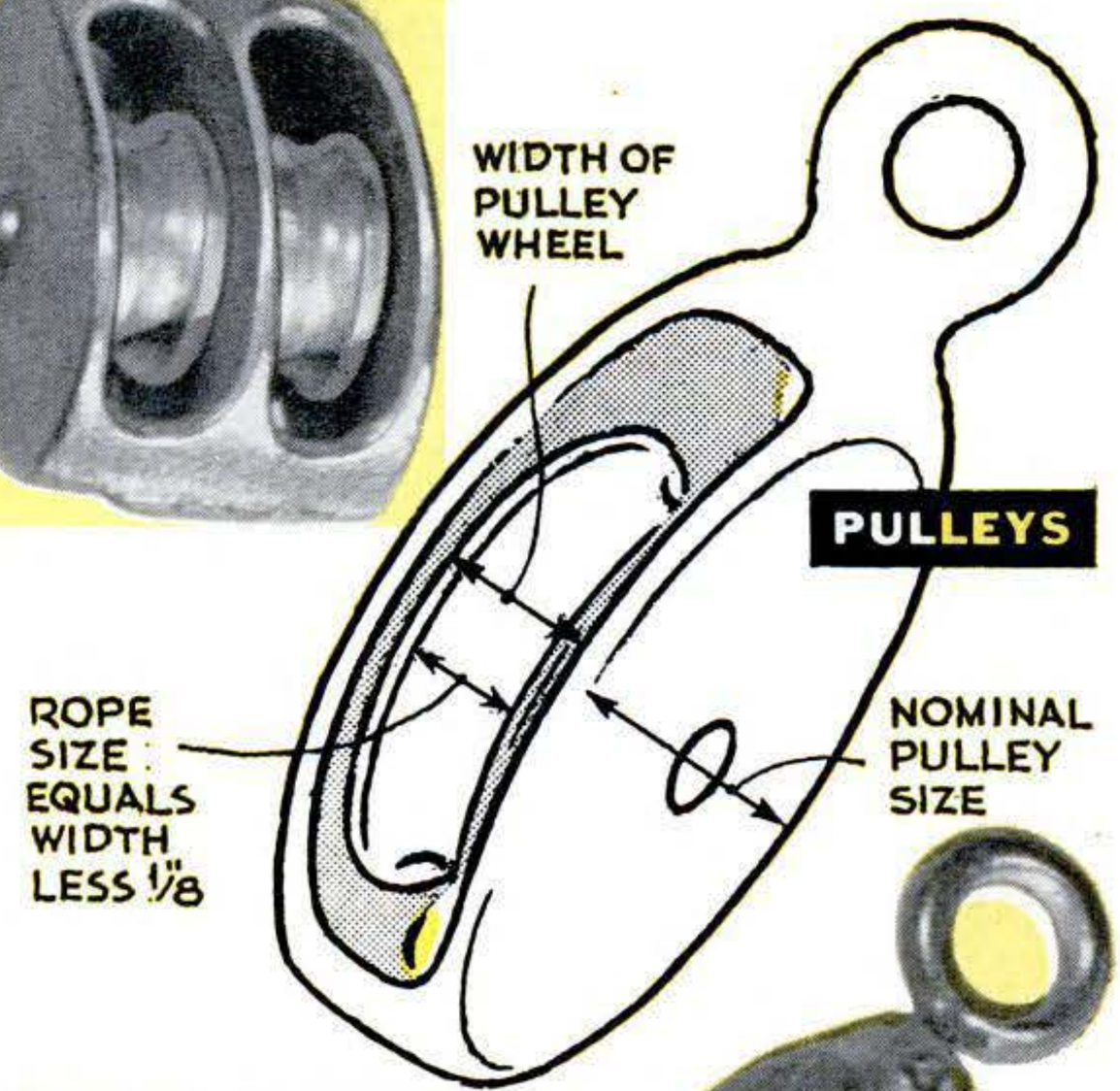
Special Hardware You Should Know About (2)

materials file





FOR jobs around the home, common pulleys, classed as swing type, come with either one or two pulley wheels, or sheaves. Sizes can be confusing because nominal size often means pulley diameter. The important dimension is the sheave width since this determines the size of rope it can take. Choose a sheave 1/8" wider than the rope diameter. Pulleys come with either swivel eyes or fixed eyes (called "fast" eyes). For very heavy loads, one-piece fast eyes are stronger. Where lines may twist, swivel eyes help prevent fouling.

STANDARD PULLEY SIZES

Nominal Size	Wheel Width	Rope Dia.
1/2"	9/32"	5/32"
3/4"	5/16"	3/16"
1"	3/8"	1/4"
1 1/4"	7/16"	5/16"
1 1/2"	7/16"	5/16"
1 3/4"	1/2"	3/8"
2"	9/16"	7/16"
2 1/2"	3/4"	5/8"

LAG SCREW FOR THICK WOOD

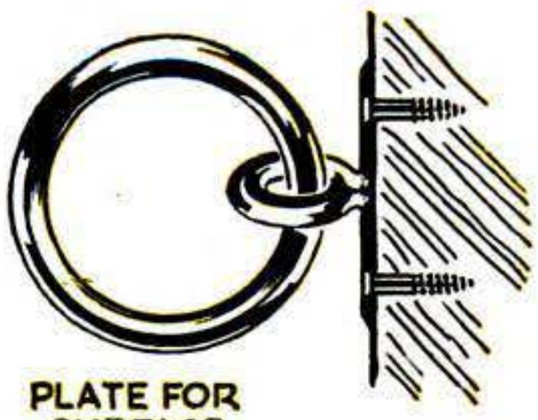
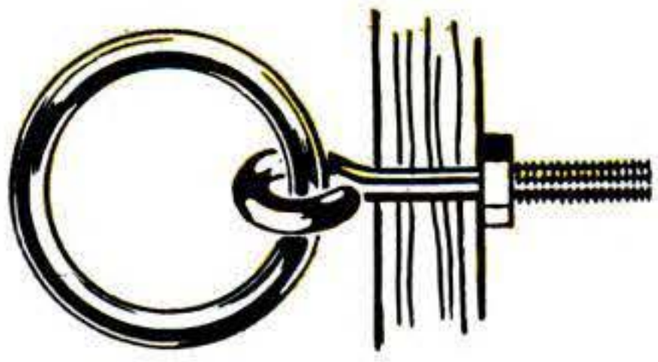
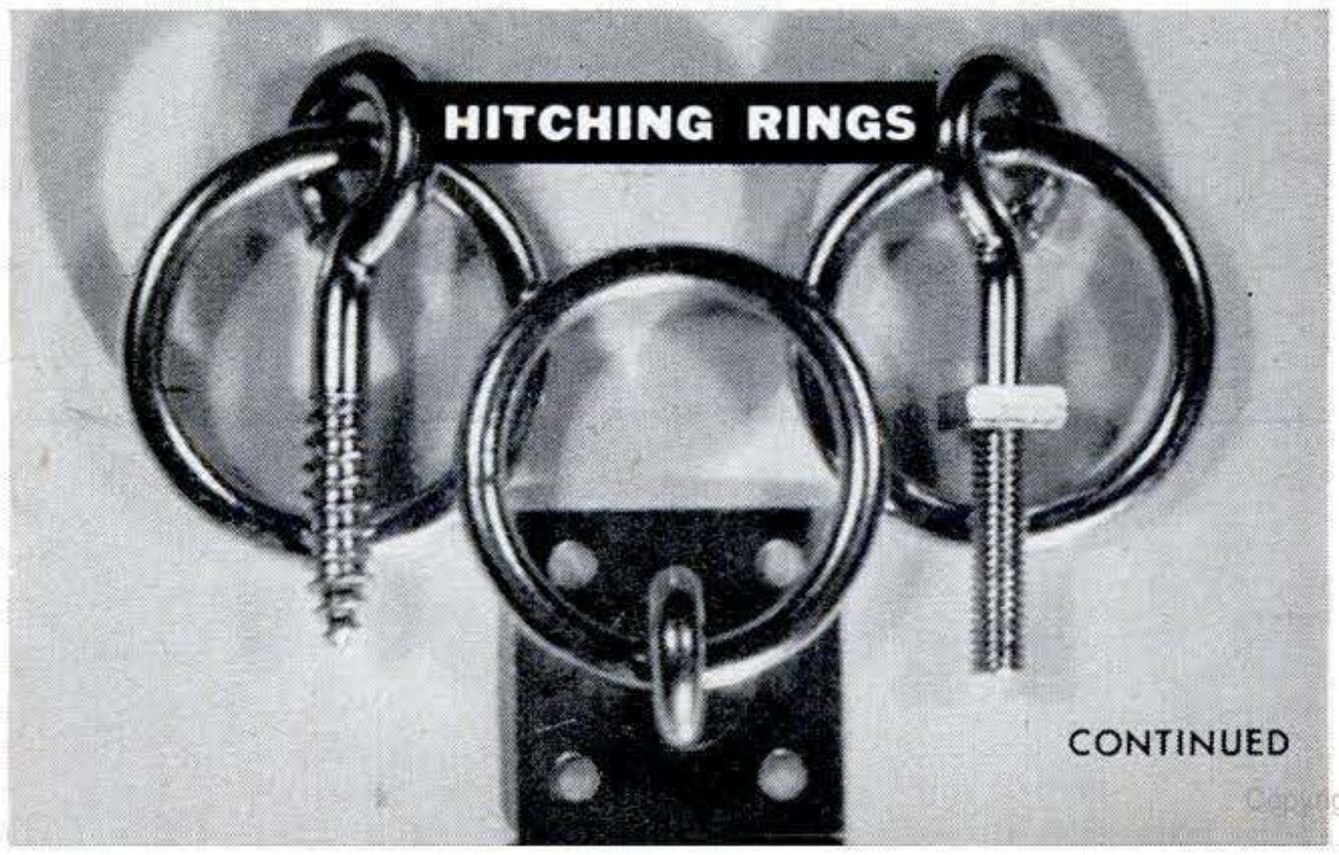


PLATE FOR SURFACE MOUNTING



BOLT FOR THIN WOOD

HITCHING rings, a hangover from horse-and-buggy days, are still popular for special jobs. Their big 2" openings make it easy to tie lines quickly and to use heavy ropes, as for mooring boats. The rings are also free to pivot under the strain of moving lines, like those for tethering pets. Three styles permit attaching them with a lag screw into wood, a bolt through wood, or a plate screwed to the surface. Such rings are made by the Washburn Co., Worcester, Mass.



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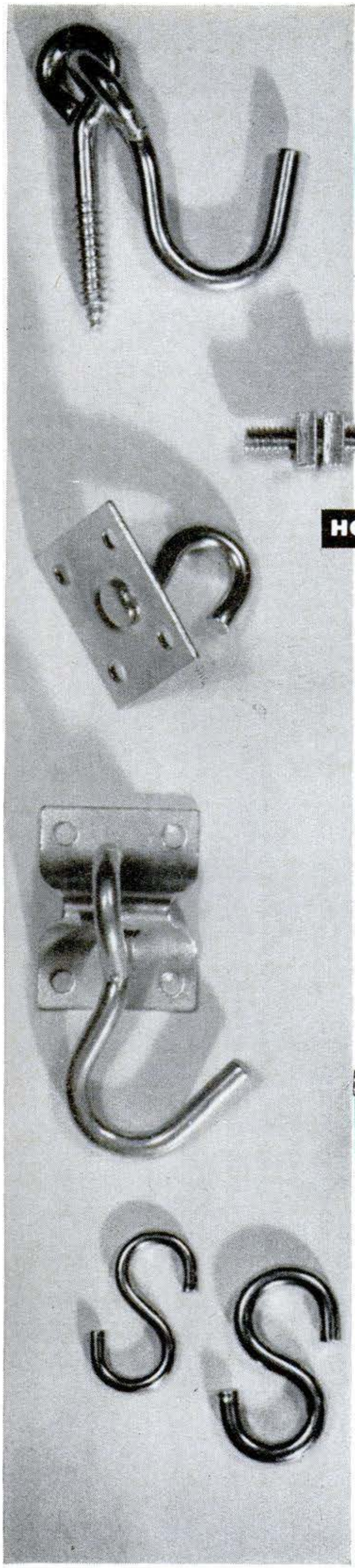
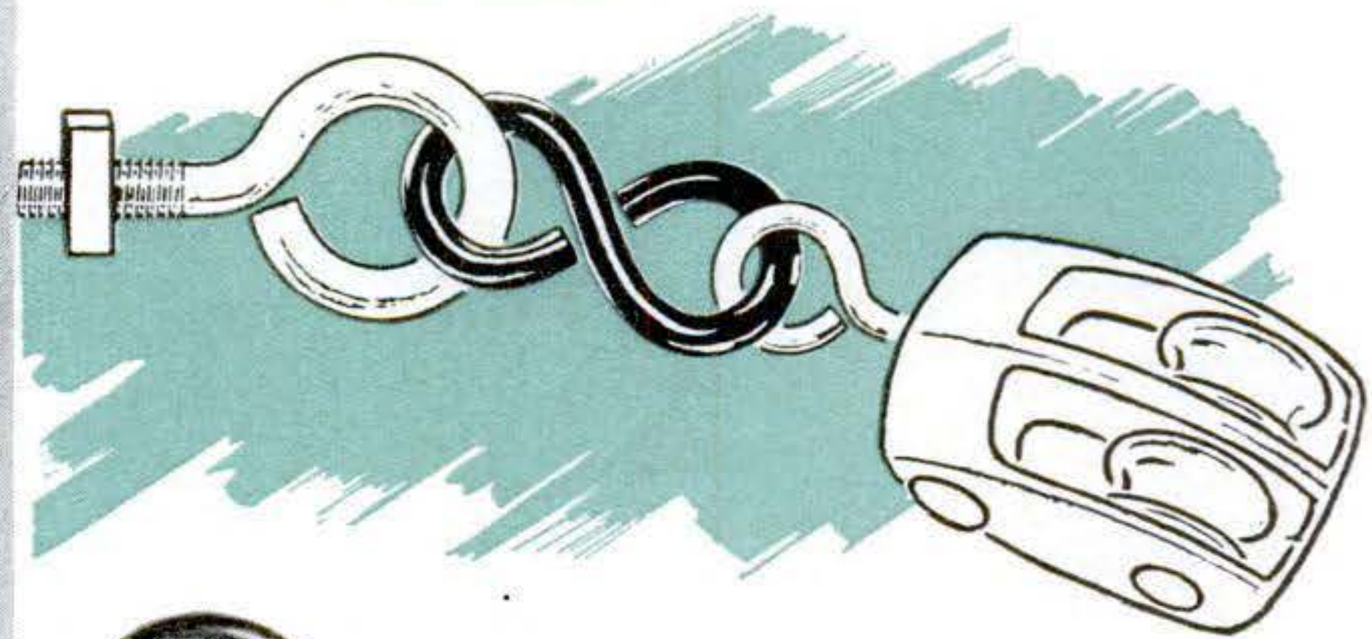


HOOKS

FOUR special hooks often solve problems where ordinary screw hooks won't serve. One has a super-long 5″ shank with ⅜″ machine thread, permitting it to bolt right through four-by-four posts and tree limbs to anchor heavy lines. The hook below it has a 2″-square plate for surface mounting on thin wood, or on thick wood where you can't reach behind to fasten bolts. The two other hooks are flexibly attached to support swinging or hanging loads, such as a hammock. This allows them to move with the weight, saving wear on the line. You can get them with either a lag screw for thick wood or attached to a plate for surface mounting.



S HOOKS offer a quick and inexpensive way of joining two fittings that have closed eyes or two lengths of chain. To form a permanent link, squeeze the ends of the S closed. The hooks are sold according to their length from end to end and come in sizes from ¾″ up to 3″. Larger sizes are of heavy-gauge ½″ and $\frac{5}{16}$″ wire and take tremendous loads.

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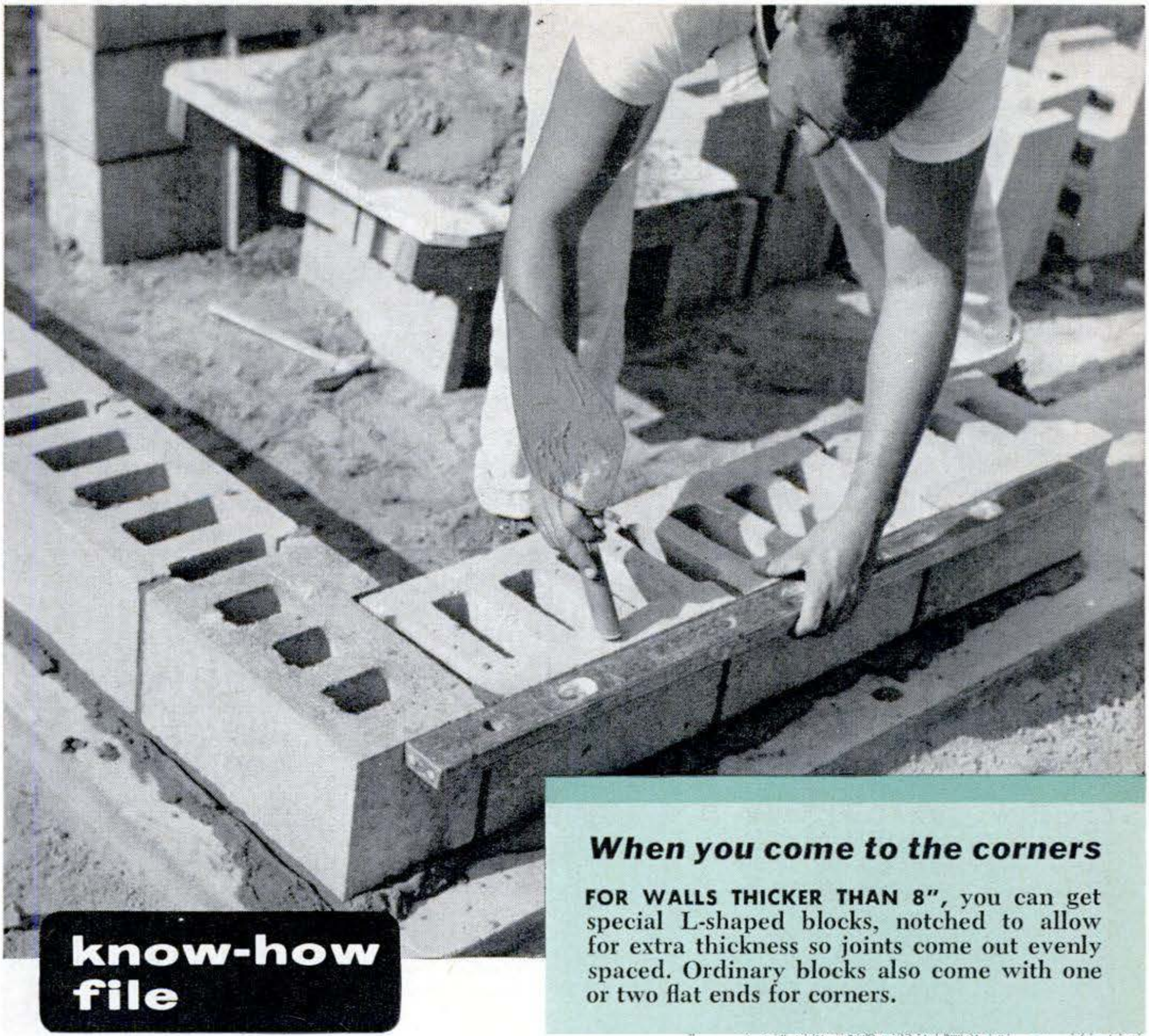


know-how file

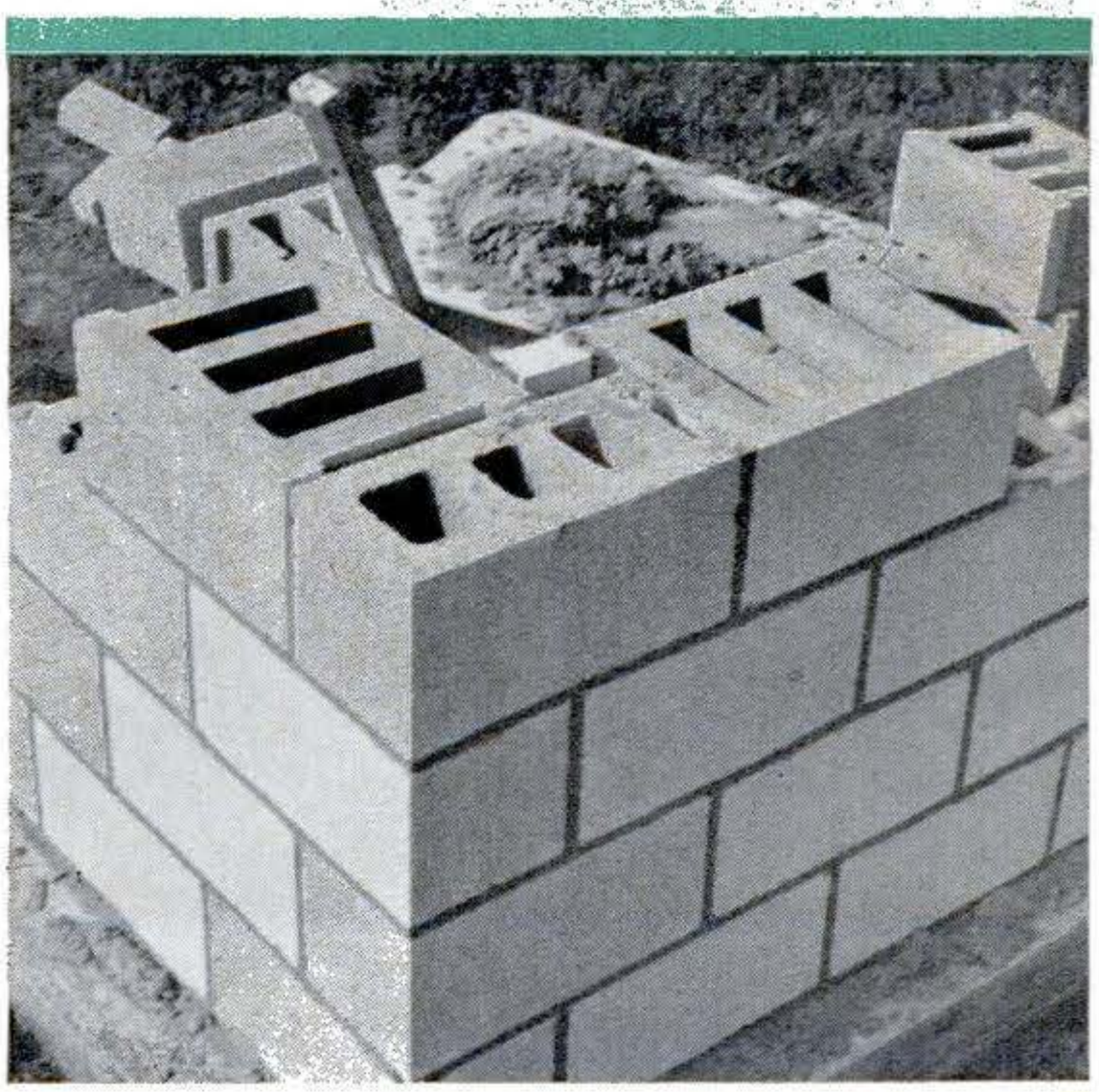
When you come to the corners

FOR WALLS THICKER THAN 8", you can get special L-shaped blocks, notched to allow for extra thickness so joints come out evenly spaced. Ordinary blocks also come with one or two flat ends for corners.

CORNER CAN BE BUILT UP this way if L-shaped blocks aren't available. Use an 8" corner block and fill in gap at back with a masonry brick. This keeps all joints on 8" spacing regardless of the thickness of the blocks.

Building a wall? Try these tips on—

Laying Up Concrete Blocks



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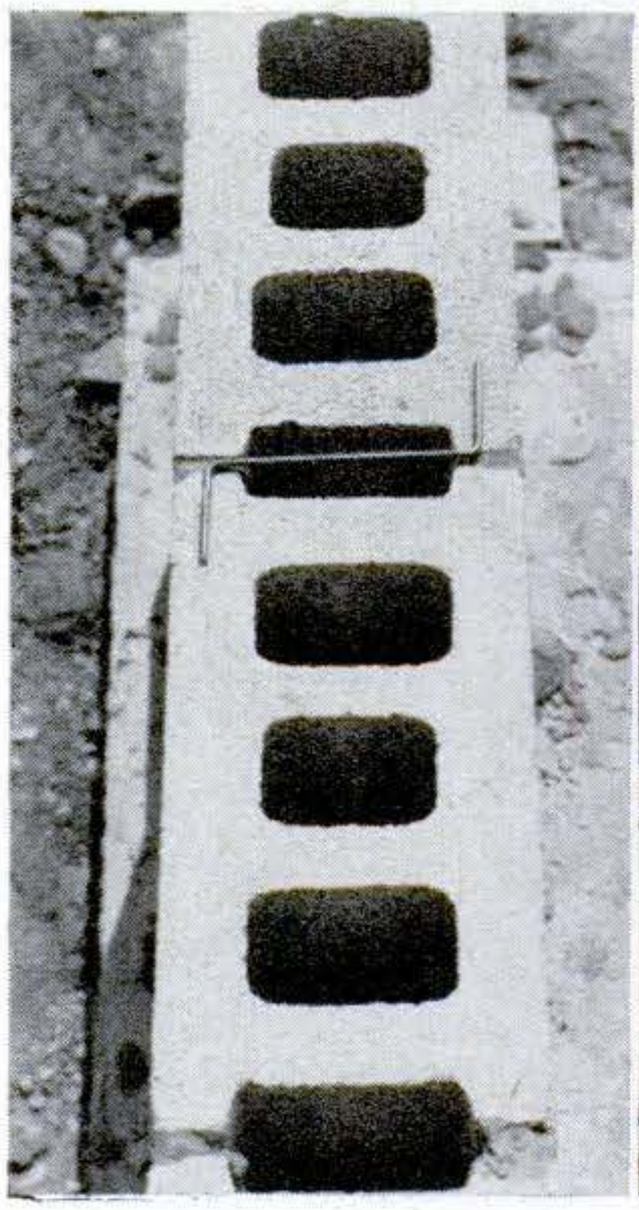
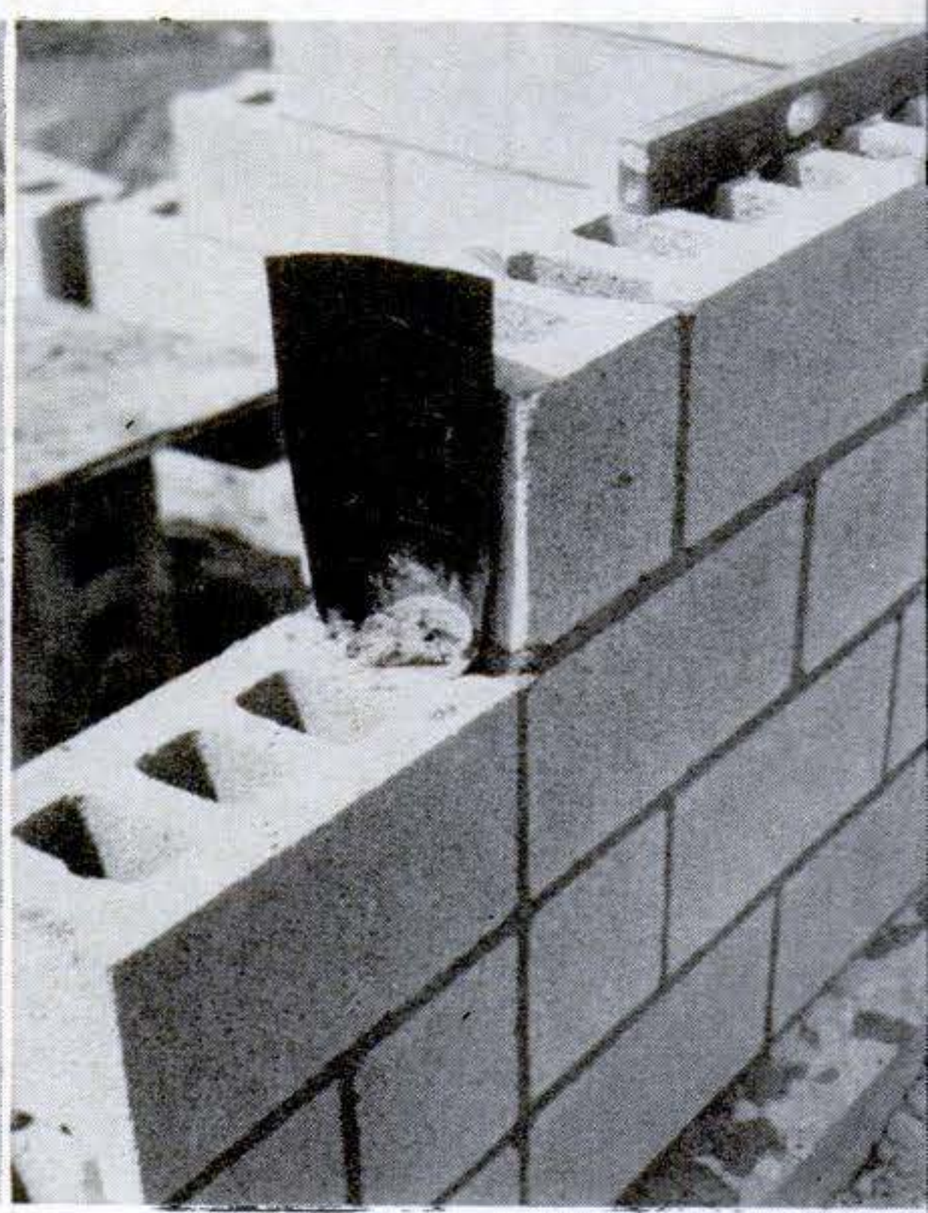
How to install anchor bolts for wood plates

WOOD PLATES, used to tie house walls to the foundation, are fastened on with bolts cemented into core holes in the concrete blocks. Bolts are ½" diameter, 18" long, and extend two courses deep in the blocks. To keep mortar from falling all the way down the holes, mark where bolts will go and place squares of metal lath over holes in the second course from the top, as at far right. Space the bolts not more than 4' apart and extend the threaded ends above the wall to allow for thickness of the wood plates, usually two-by-sixes or two-by-eights.

Vertical control joints take up the stresses

CONTROL JOINTS — continuous vertical joints at intervals—keep large walls from cracking by letting them shift in sections. One type (near right) uses Z-shaped tie bars across joints for lateral support. Another type (second on right) is made by filling ends of blocks with mortar for strength, but keeping it from sticking to adjacent blocks with sheets of roofing paper. On all joints, seal outer seams with calking compound. Since this is elastic, joint will give if the wall shifts.





How to tie one concrete wall to another

WHERE WALLS MEET, they should not be tied together in a rigid masonry bond. Let one wall end at the face of the other wall in a vertical control joint. For lateral support, load-bearing walls are joined with metal tie bars, as at right. These are ¼" thick, 1¼" wide, and 28" long, with 2" tabs bent at the ends. The tabs are embedded in core holes filled with mortar. Metal lath under the cores holds the mortar. Use tie bars in at least every sixth course.

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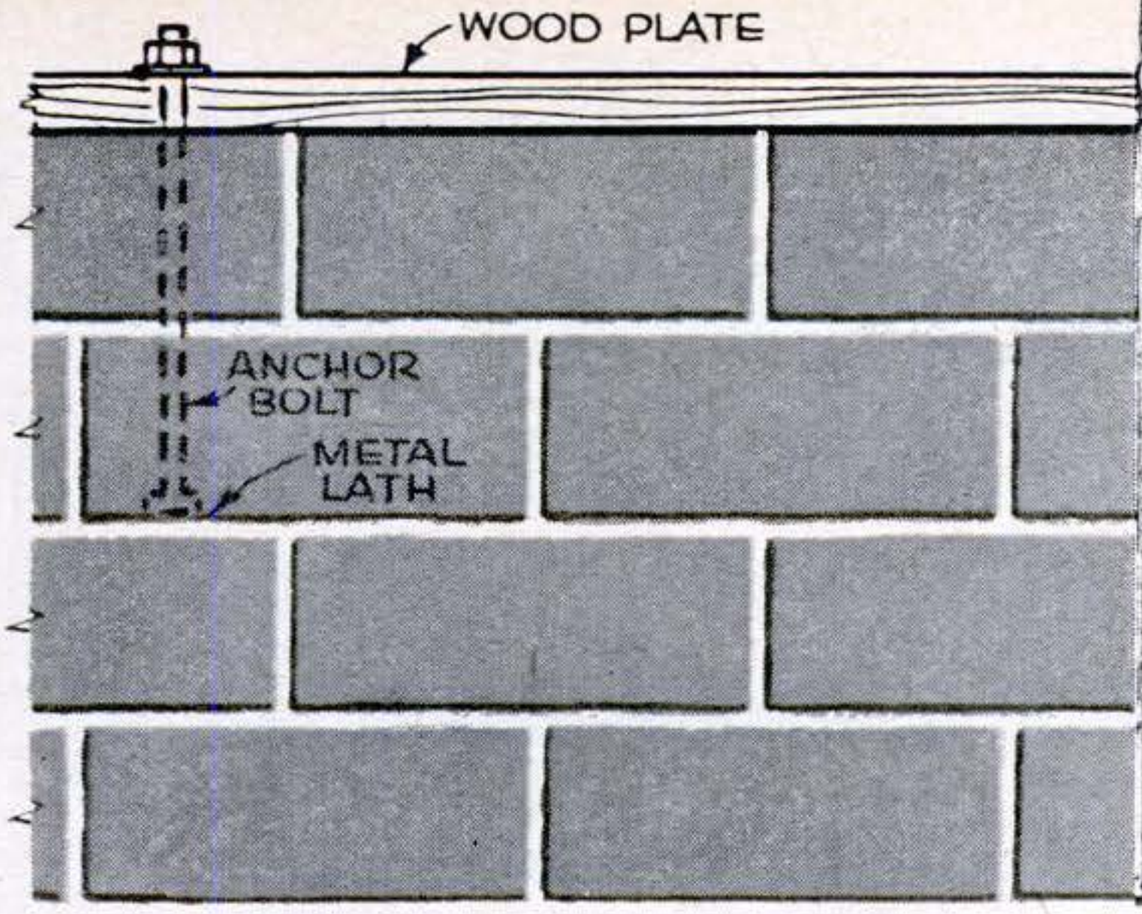
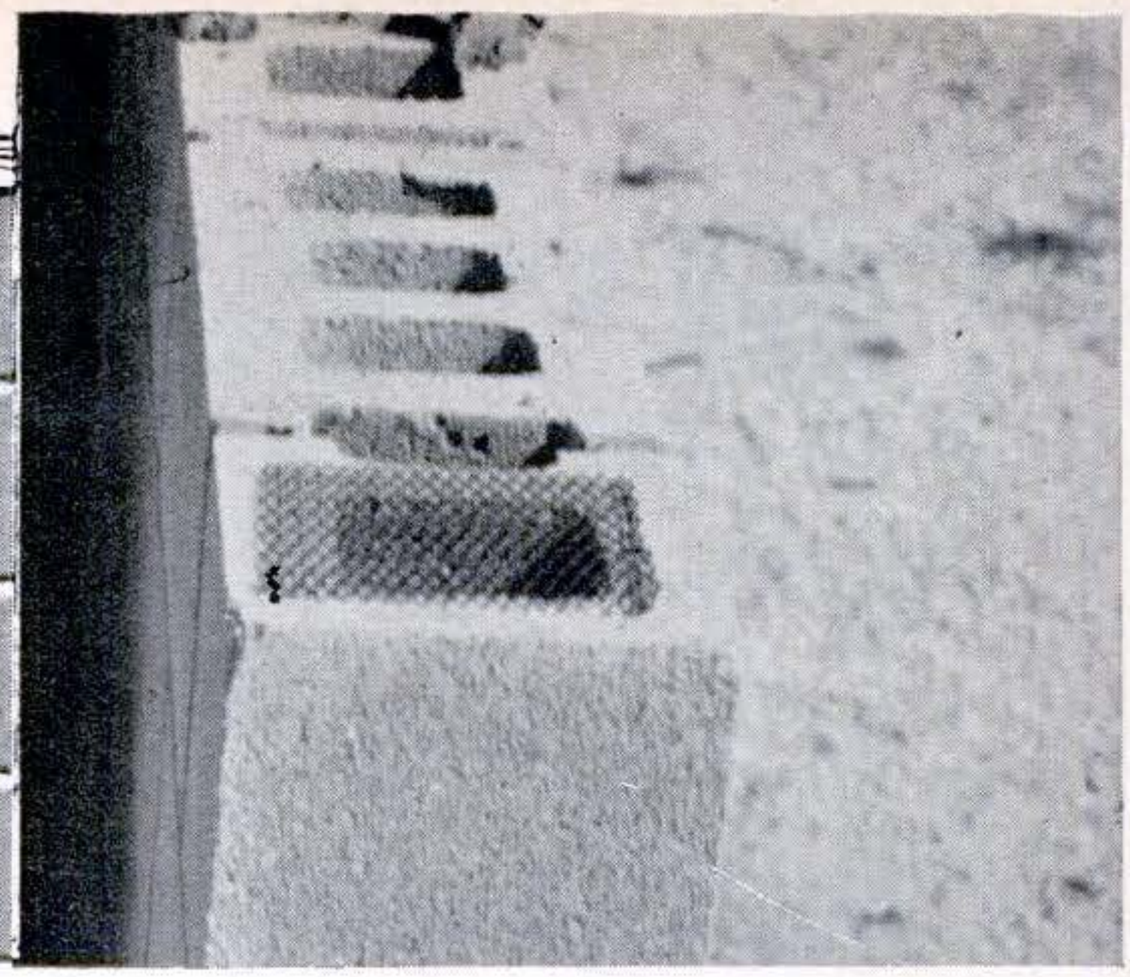
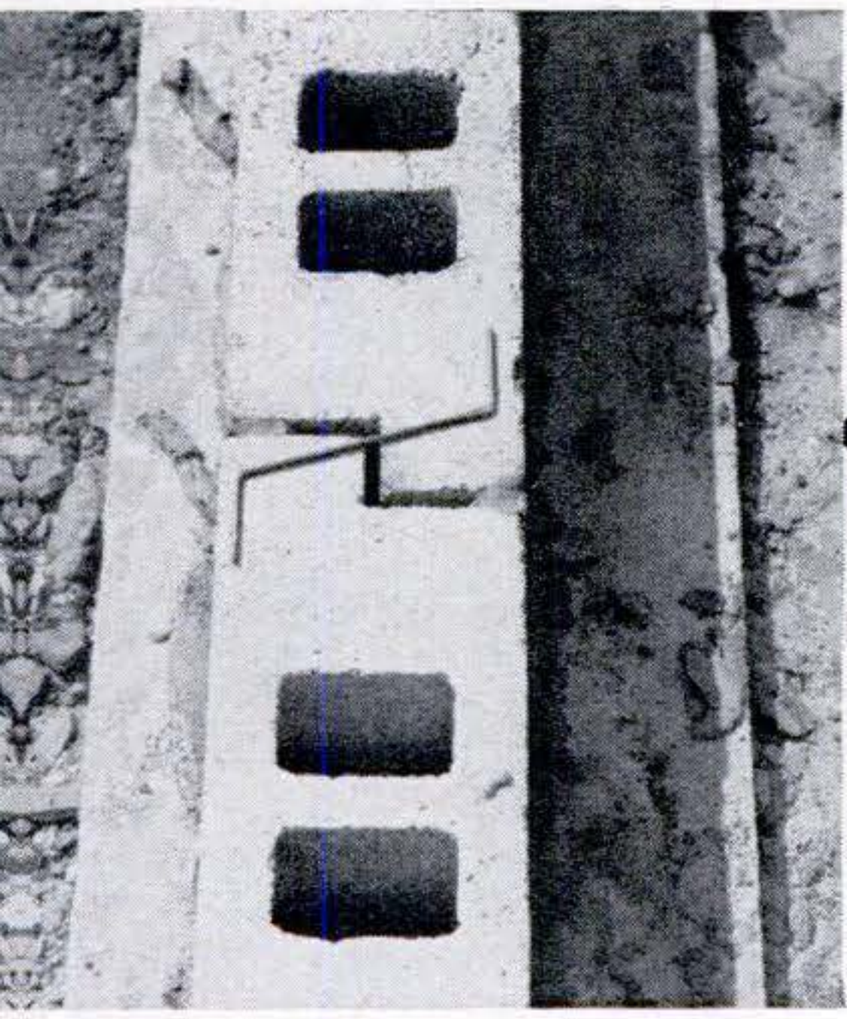
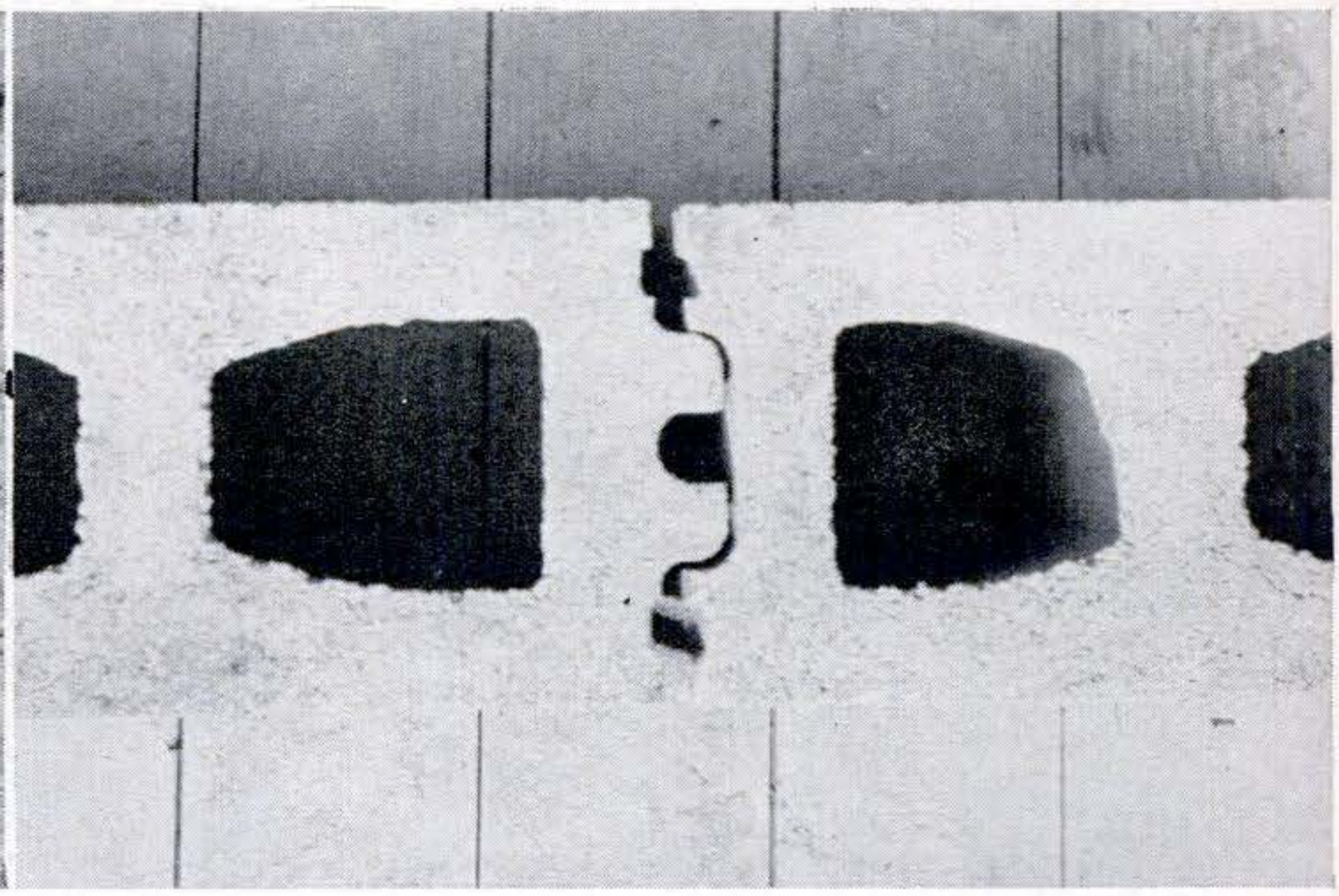
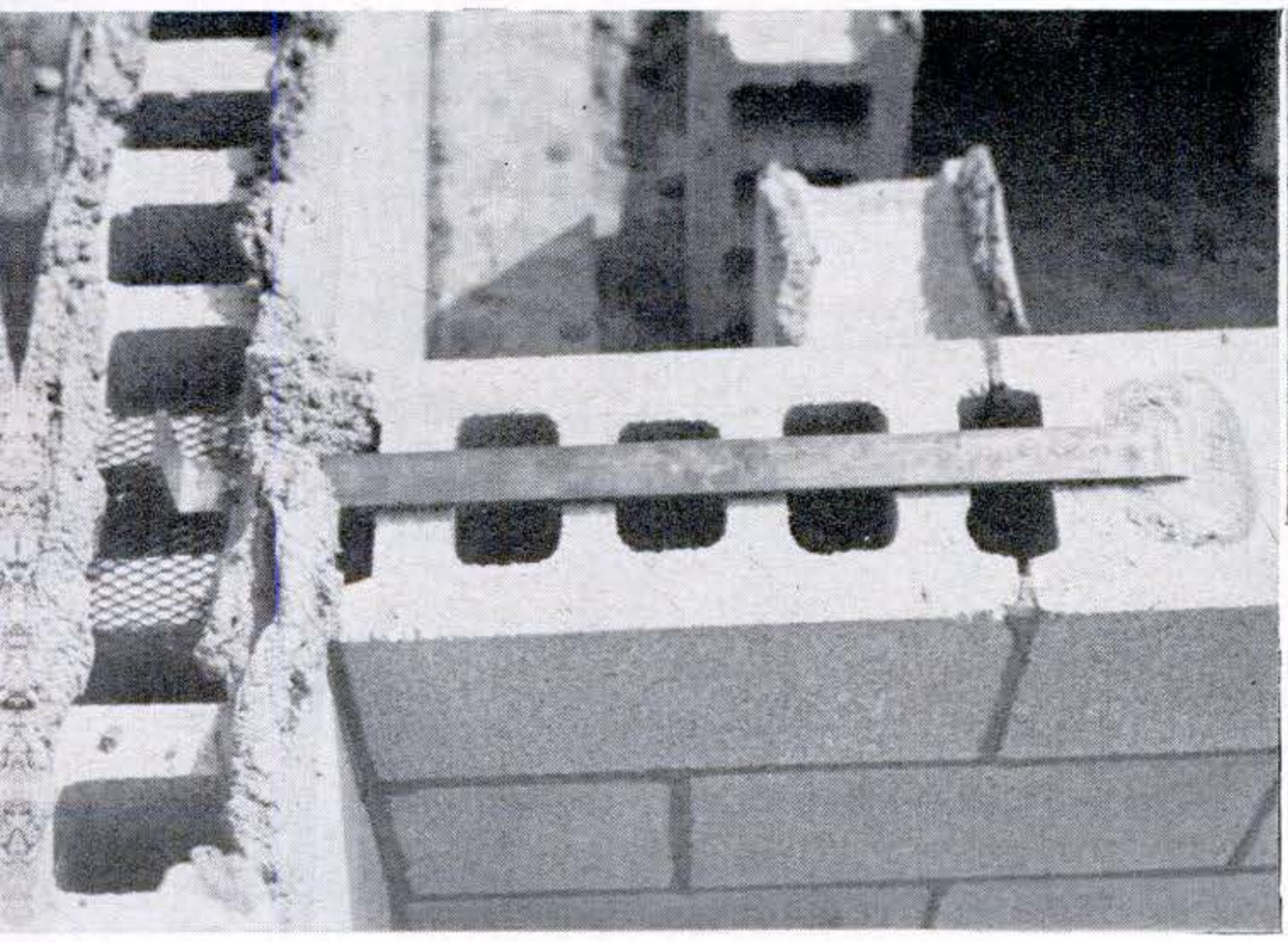


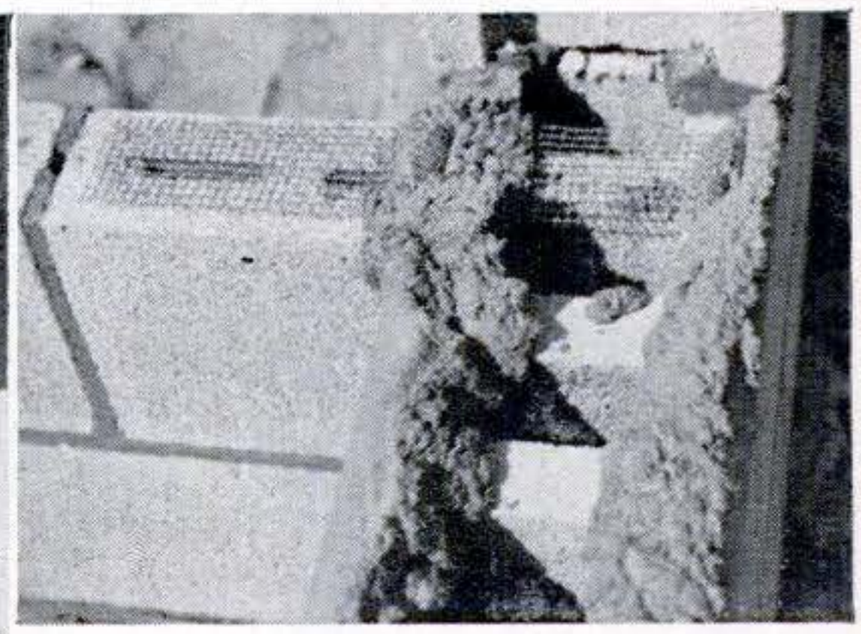






INTERLOCKING BLOCKS offer quick way of making strong control joints. Overlapped jamb blocks at left require an open-Z tie bar across. Tongue-and-groove block above needs no tie.





NON-LOAD-BEARING WALLS do not need tie bars where they meet another wall. They can be tied in place with strips of metal lath, as above, placed across the joint on every second course. As with other control joints, be sure to calk the seams.

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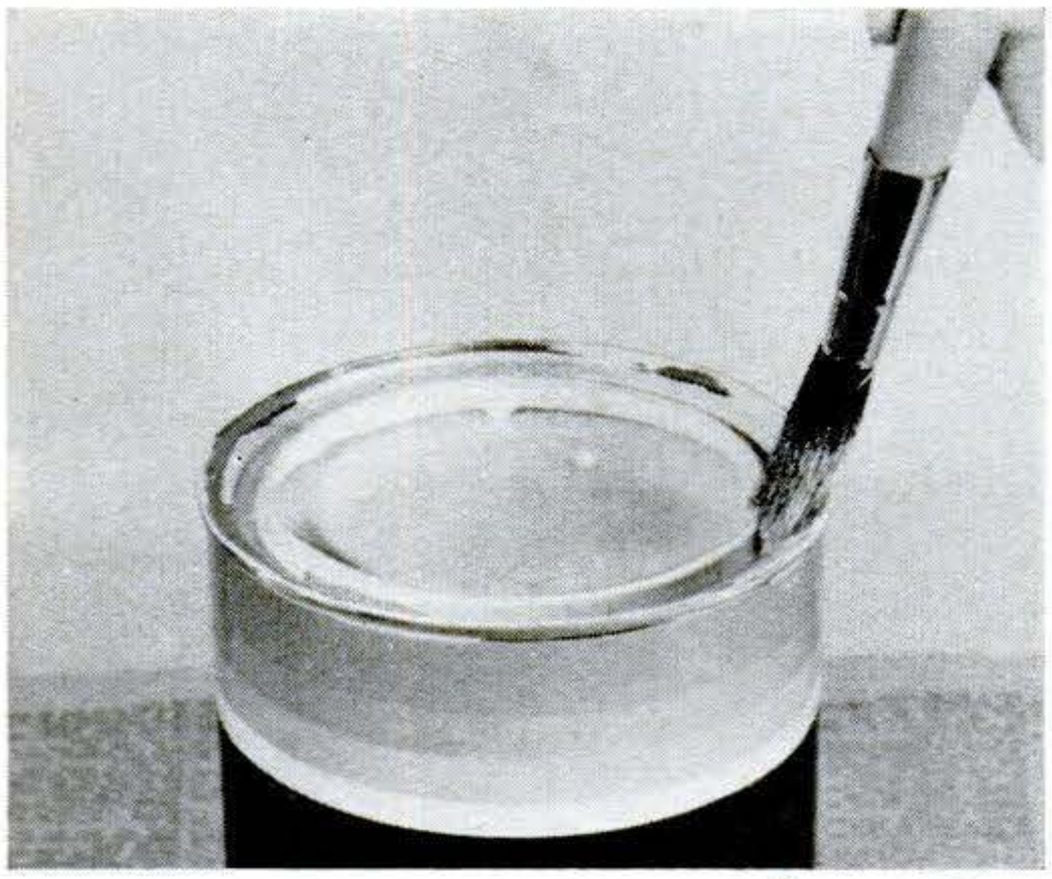
5 Steps to a Tidier Paint Routine

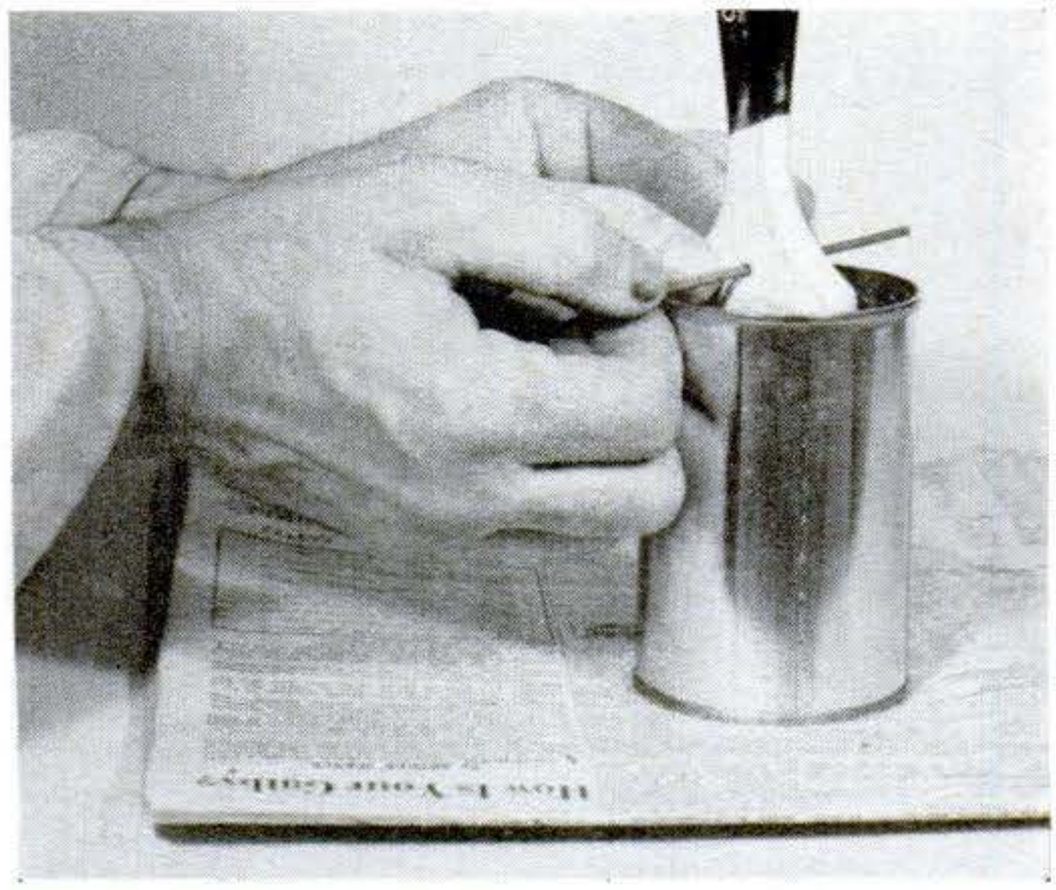
PREVENT DRIPS while mixing paint by extending can's height with newspaper held on with rubber bands. This also keeps label clean so you can easily identify paint for future use.



BRUSH PAINT OUT OF CAN RIM to keep it from squeezing out and spilling when the lid is replaced. Where possible, try to paint directly from the can to eliminate messy pouring.

STOP PAINT FROM SPATTERING all over the place when you close the can by covering the top with an old cloth. Then seal the lid firmly in place, tapping all around with a hammer.

KEEP PAINT FRESH by turning the can upside down for several minutes before putting it away. This forms a seal around the lid to keep out air and prevent paint from thickening.

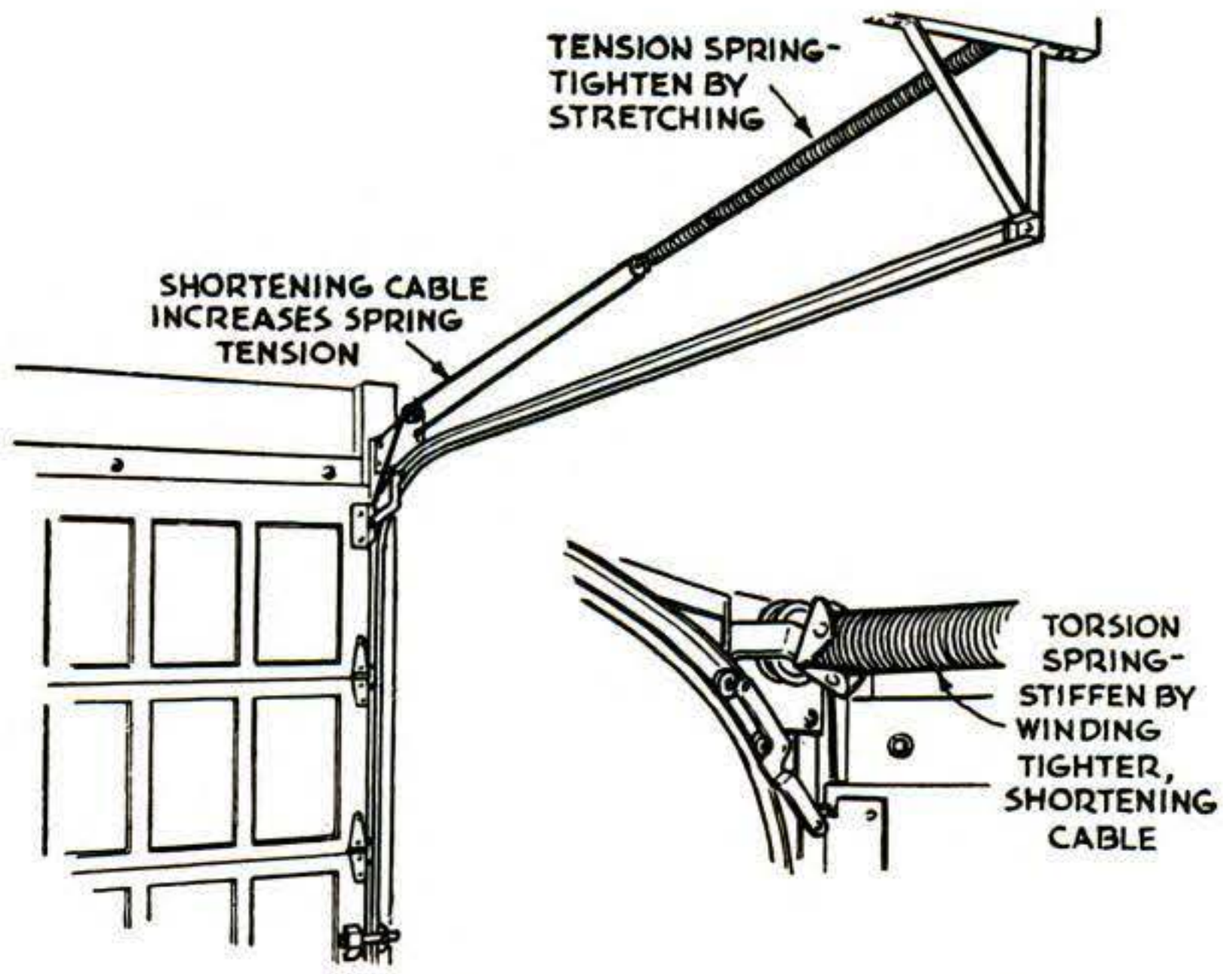


STORE BRUSHES NEATLY by suspending them in cans, with wires through the handles, this way. Clean them first, then keep them immersed in boiled linseed oil or solvent, ready for use.

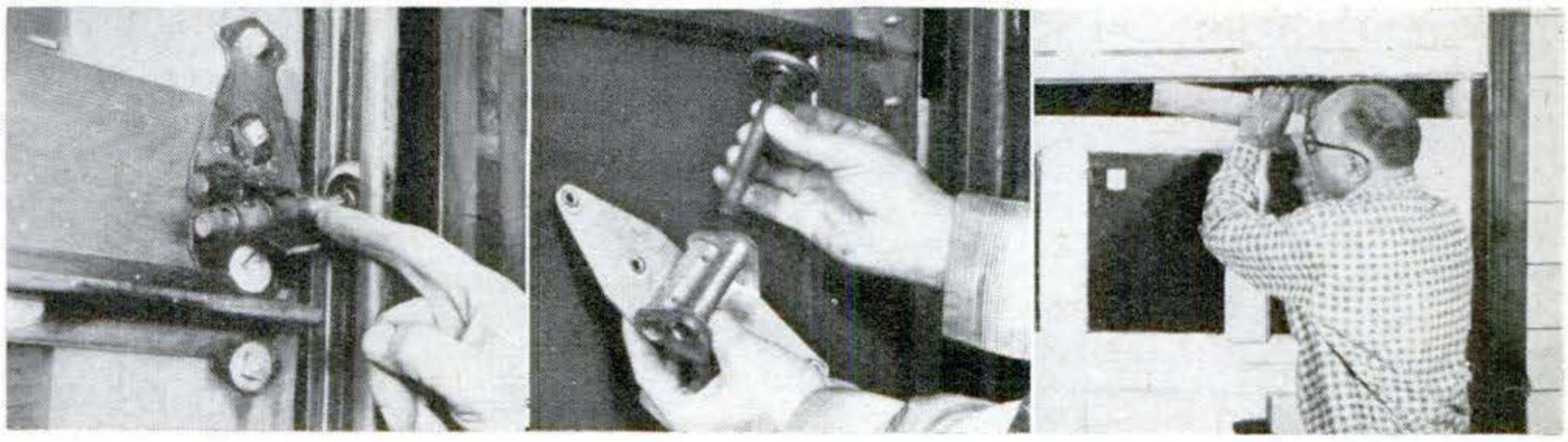
Copyrighted material

Garage Door Hardware

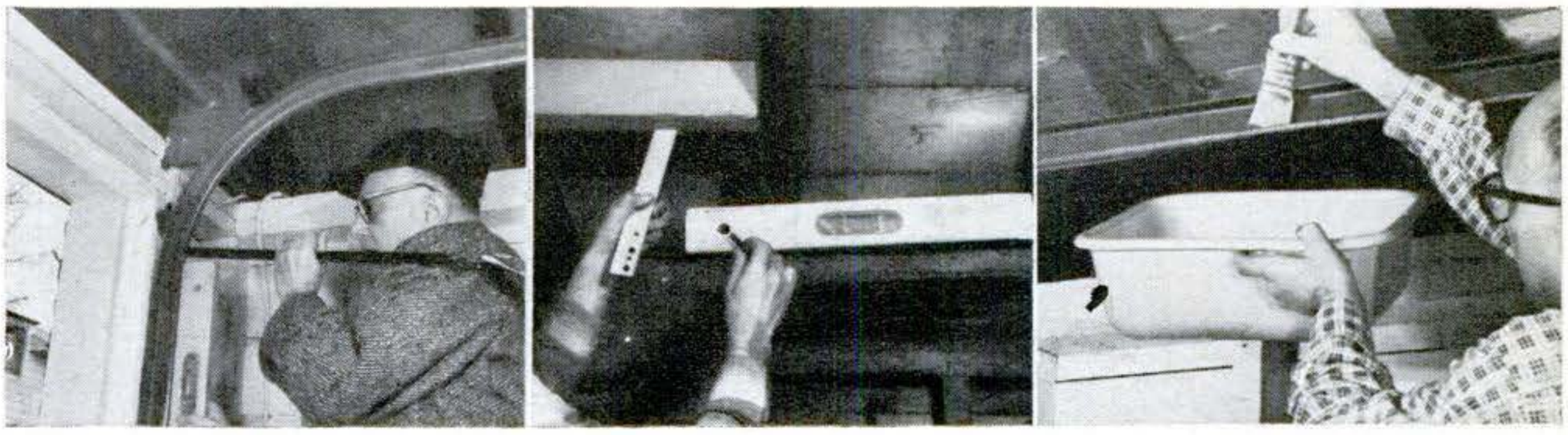
OVERHEAD DOORS are of two kinds—roll-up and tilt-up. Two types of springs are used to counterbalance typical roll-up doors. The springs twist (far right) or stretch (near right) when the door is closed. Stored energy helps reopen the door. Adjusting the spring tension is normal maintenance — the doors gain weight with each paint job and the springs stretch with age and constant use.



What to do if the door drags



COMMON CAUSE of this trouble is a broken roller shaft or a loose hinge. Replacement parts aren't standardized. Therefore they must be brand-duplicated. A surface-mounted roller on a roll-up door (left and center) can be removed without separating the door sections. Doors with end-mounted hinges and rollers must be taken apart. A block can be used, as at right, to keep the sections apart during removal of broken hardware.



OTHER CAUSES of dragging or binding doors include poor alignment of track and lack of lubrication. If you suspect bad alignment, plumb the side tracks and see that the curves are at same level. Some mounting brackets have slots for adjustment (left); others take shims or new holes. Make sure overhead track is adjusted (center) to slant slightly downward toward rear of garage so raised door won't fall. Replace any bent track; file or grind out dents. Wash out overhead tracks (right) with mineral spirits. Oil hinges and rollers with door down to minimize oil on overhead tracks. Oily tracks collect dirt.

CONTINUED

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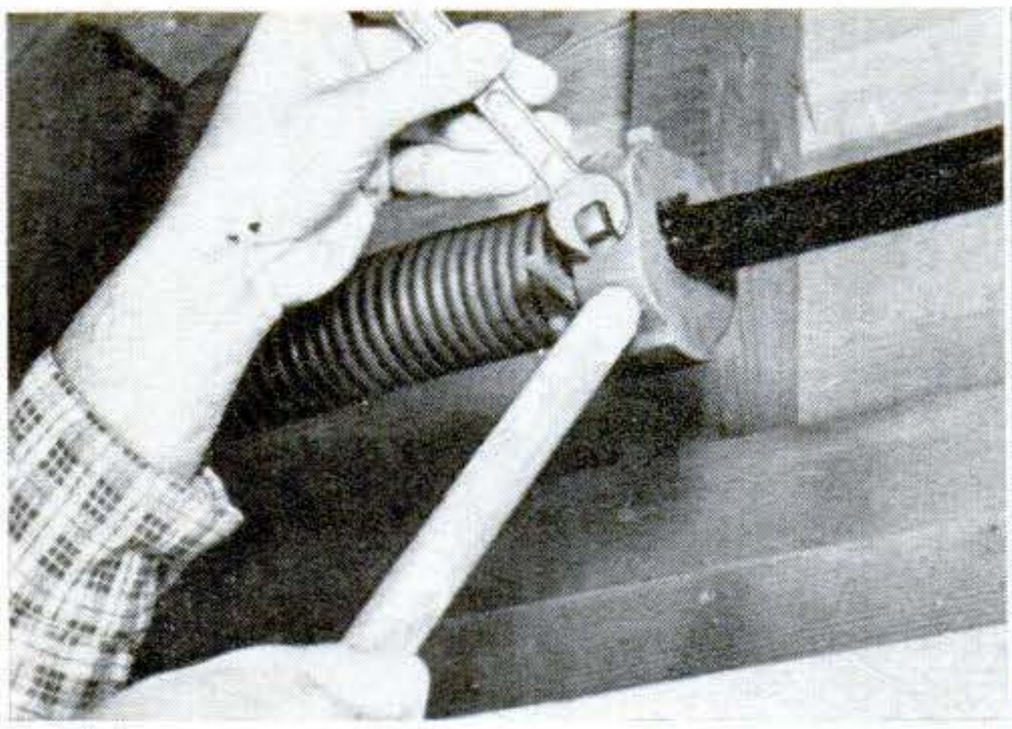
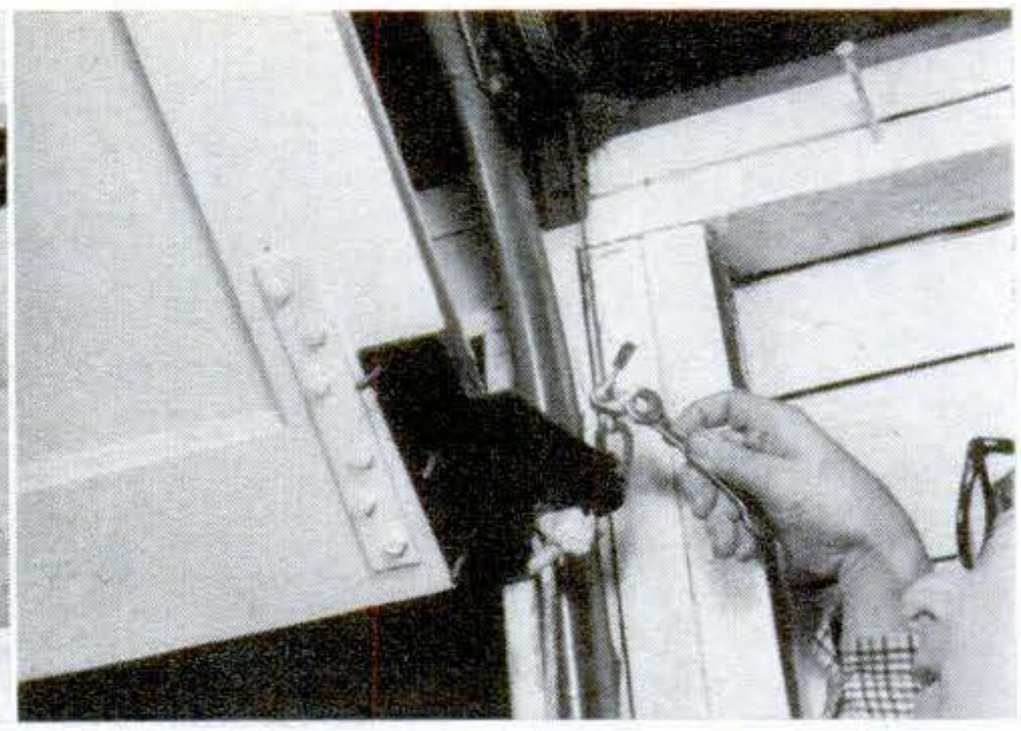
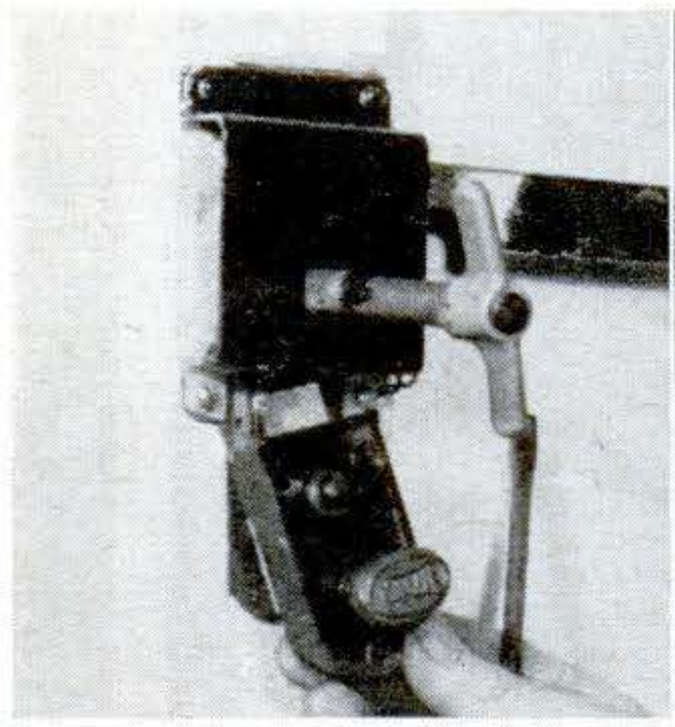
What to do if hard-to-raise doors come down fast

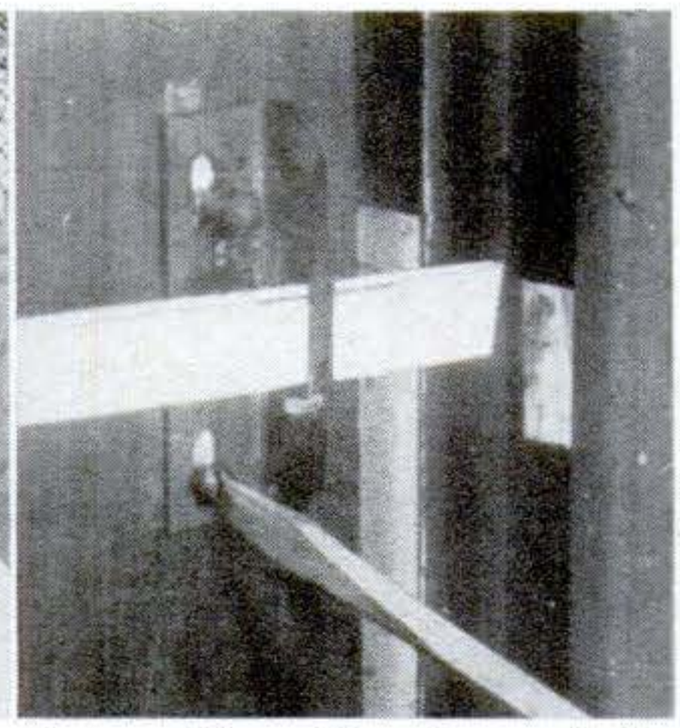




INCREASE SPRING TENSION when springs are relaxed—door raised or cables unhooked. Use a strong bar, well seated in the collar, to wind a torsion spring tighter, as at the left. Or shorten the cable with built-in tensioners, or by loosening and resetting the clamps (right). The springs must exert an equal pull to prevent crooked lift or binding. Use care not to increase tension too much or doors will be easy to raise, but hard to lower.

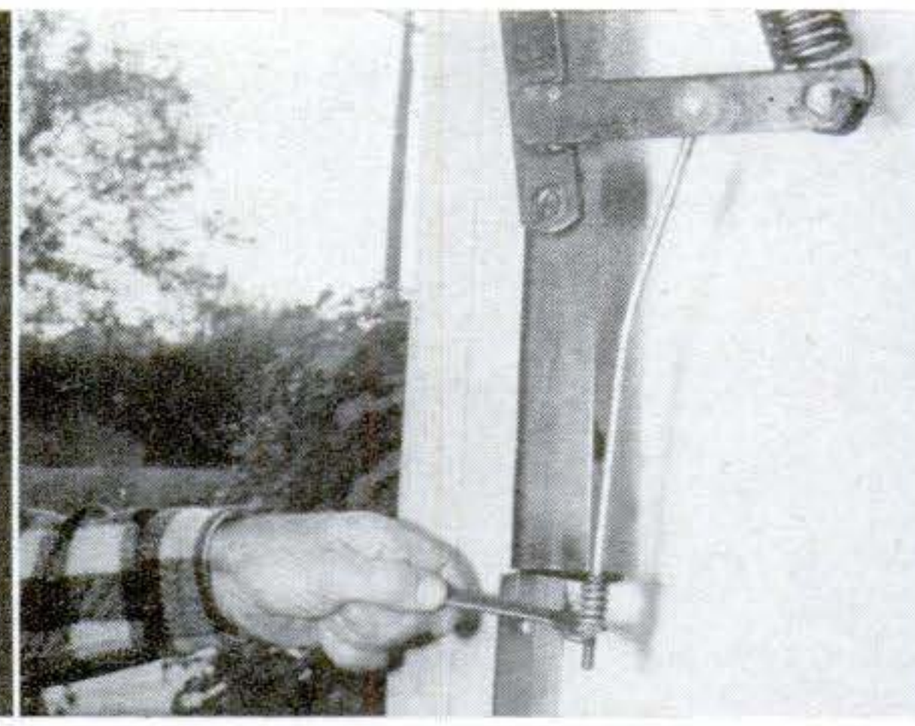
What to do with a jammed latch





YOU MUST REMOVE LOCK for access to most latches (left). A typical latch (center) includes crank to push bolt, spring to withdraw it, cam with slot to engage the lock. Broken torsion spring sometimes can be replaced by screen-door spring pulling directly on bolt. Bolt guide at door's edge may need resetting, right, to correct a sagging bolt. Oil on latch, graphite in the lock, will keep both working freely in all kinds of weather.

Helpful pointers about tilt-up doors



LIFTING MECHANISM for this type of door consists of pivoted arms and counterweight springs. Trouble comes when pivots rust or arms get bent. Replacing pivot arms is often easier than straightening bent ones. Spring tension for this type of door is a matter of tightening nut (left) at end of stretch spring (springs must have equal tension). Door-stop "bumper" (right) must snub door, be loose enough to permit full travel.

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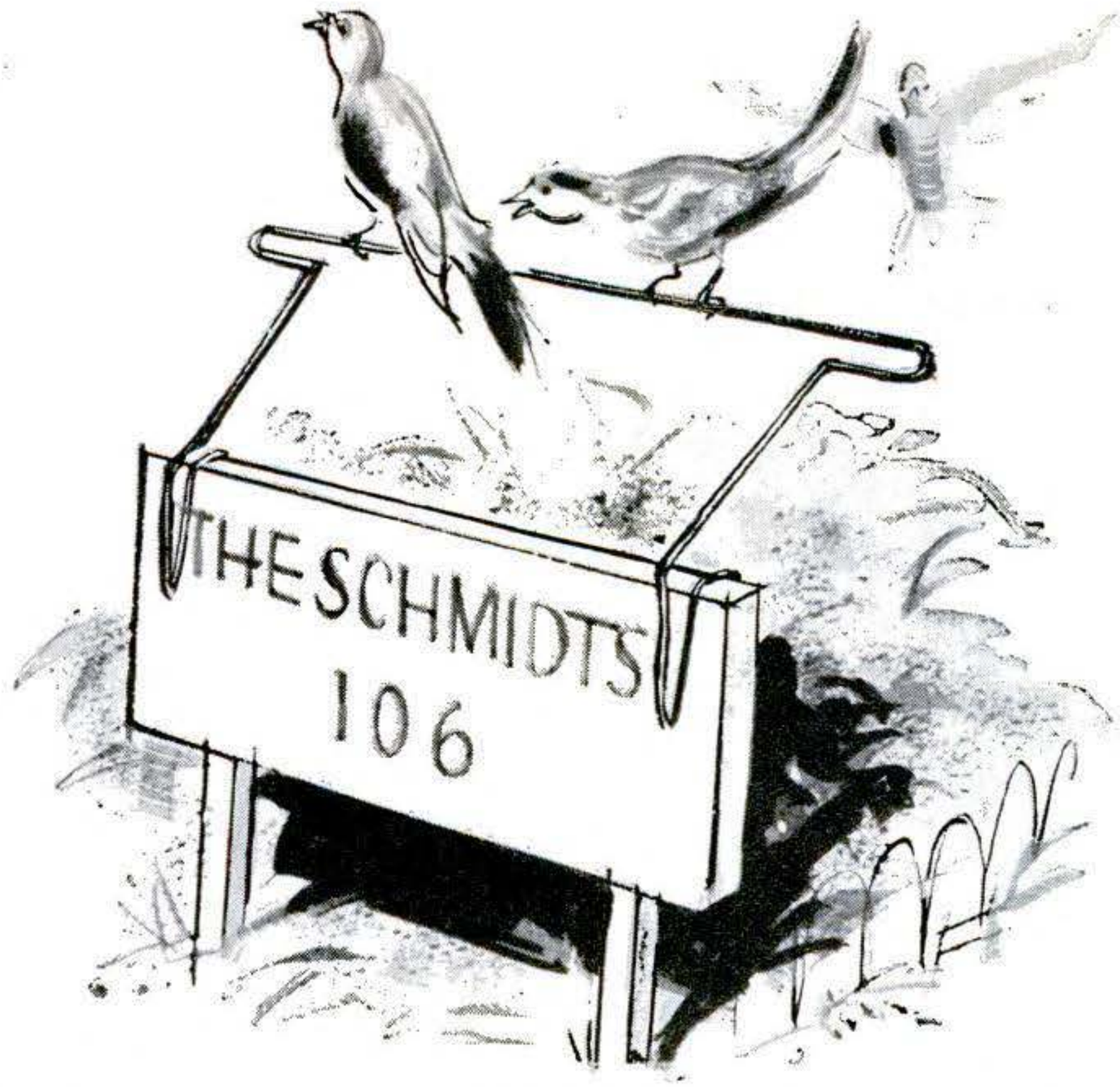


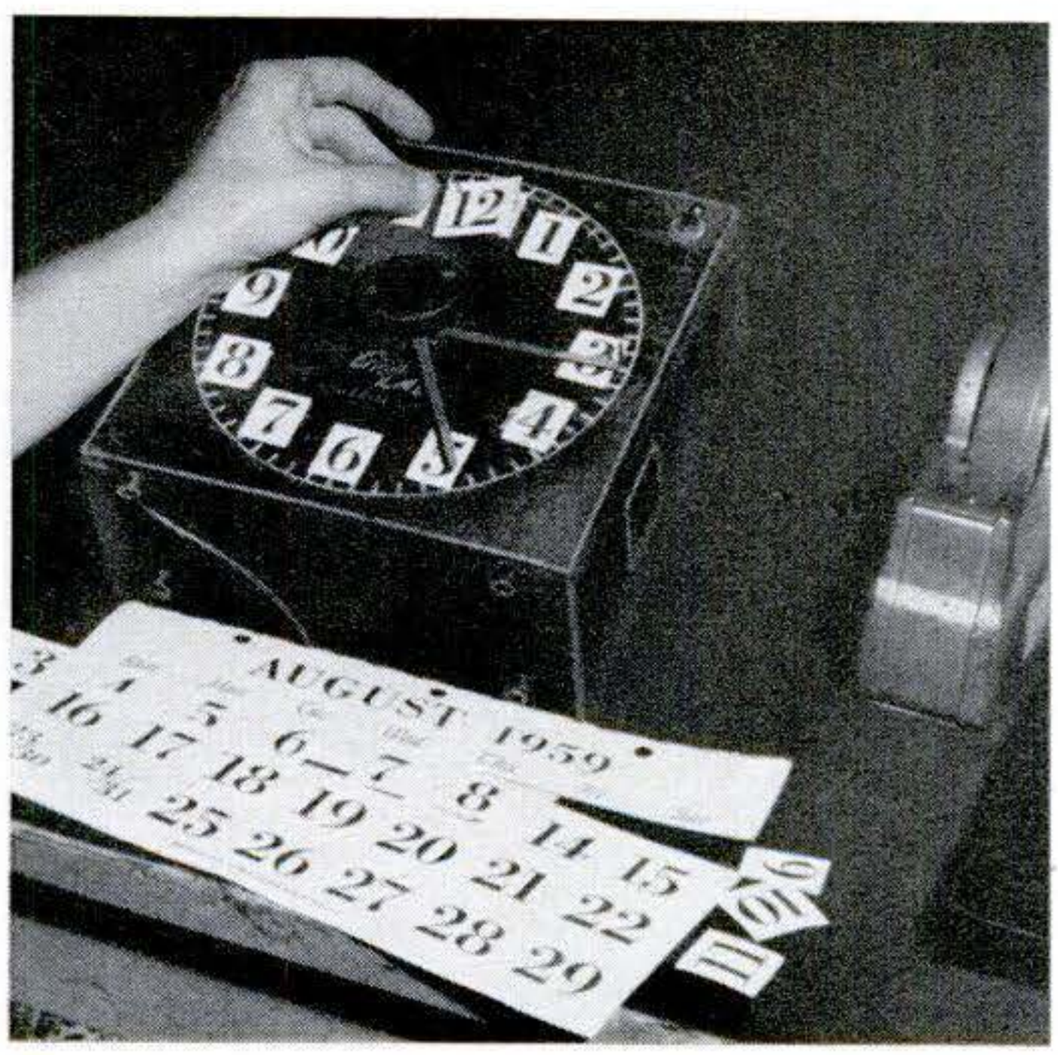
Short Cuts and Tips

FROM PS READERS

Perch Protects Signs from Birds

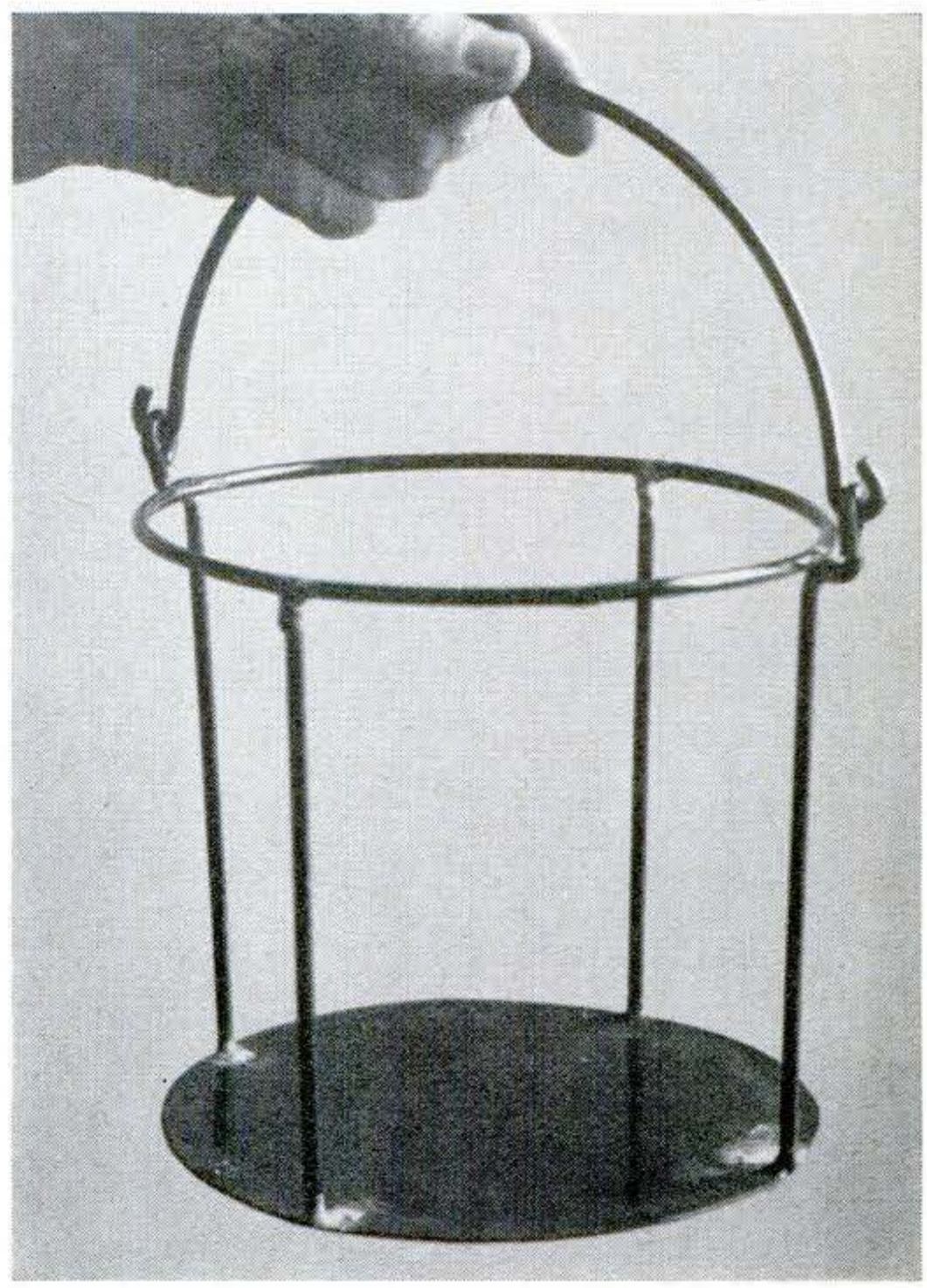
NO MATTER how beautiful you make a sign, birds often fail to get into the spirit of the thing. This was the reasoning behind offset wire perches placed on all the signs in Chalmette National Historical Park. The offset perches save park attendants hours of sign scrubbing. The idea might be adapted to home signs.—*Lyle K. Linch, Arabi, La.*

▶▶▶TO MARK a perfect cutting line on soil or other large-diameter pipe, try this: Wrap a piece of paper around the pipe so that one straight edge aligns when overlapped. Then mark with chalk or pencil. —*John Mihalic, East Liverpool, Ohio.*



New Numbers for Photo Timer

WHEN the numbers on a darkroom timer become worn and hard to read, you can replace them with numbers of uniform size cut from last month's calendar sheet. Squares of clear cellophane tape will hold the numbers in place and also serve as a tough protective covering.—*Wayne Floyd, Fayetteville, Tenn.*



Holder for Paint Cans

PAINT cans without handles can be a problem when working from a ladder. I solved it by building a cagelike holder. The bottom piece is heavy sheet iron. Using 1/4″ welding rod, I welded on four uprights (two with hook eyes) and a top ring. I also used welding rod for the handle.—*J. H. Schalek, Pittsburgh.*

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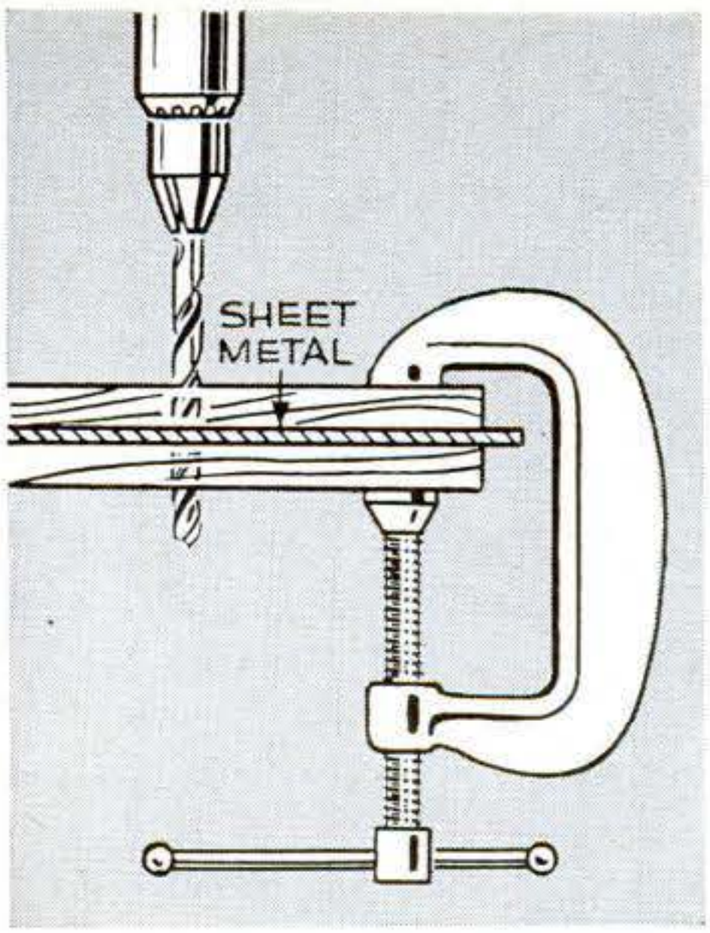
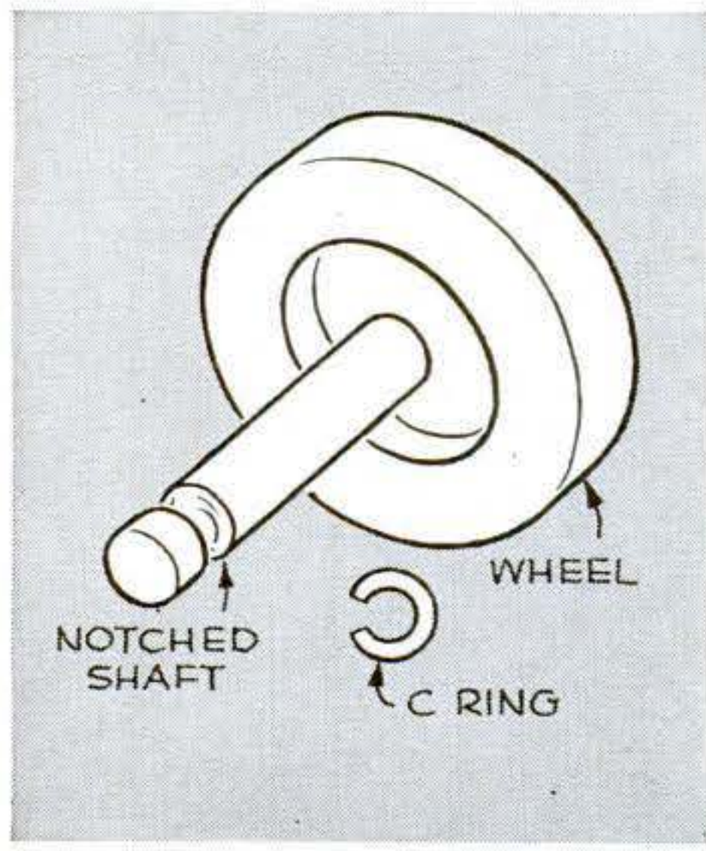


Drilling Clean Metal Holes

WHEN drilling sheet metal, I always clamp it between two pieces of scrap hardwood lumber and drill through both wood and metal. I find that this "sandwich" prevents grabbing, keeps edges smooth.—*Ernest Jewel, Argyle, Minn.*

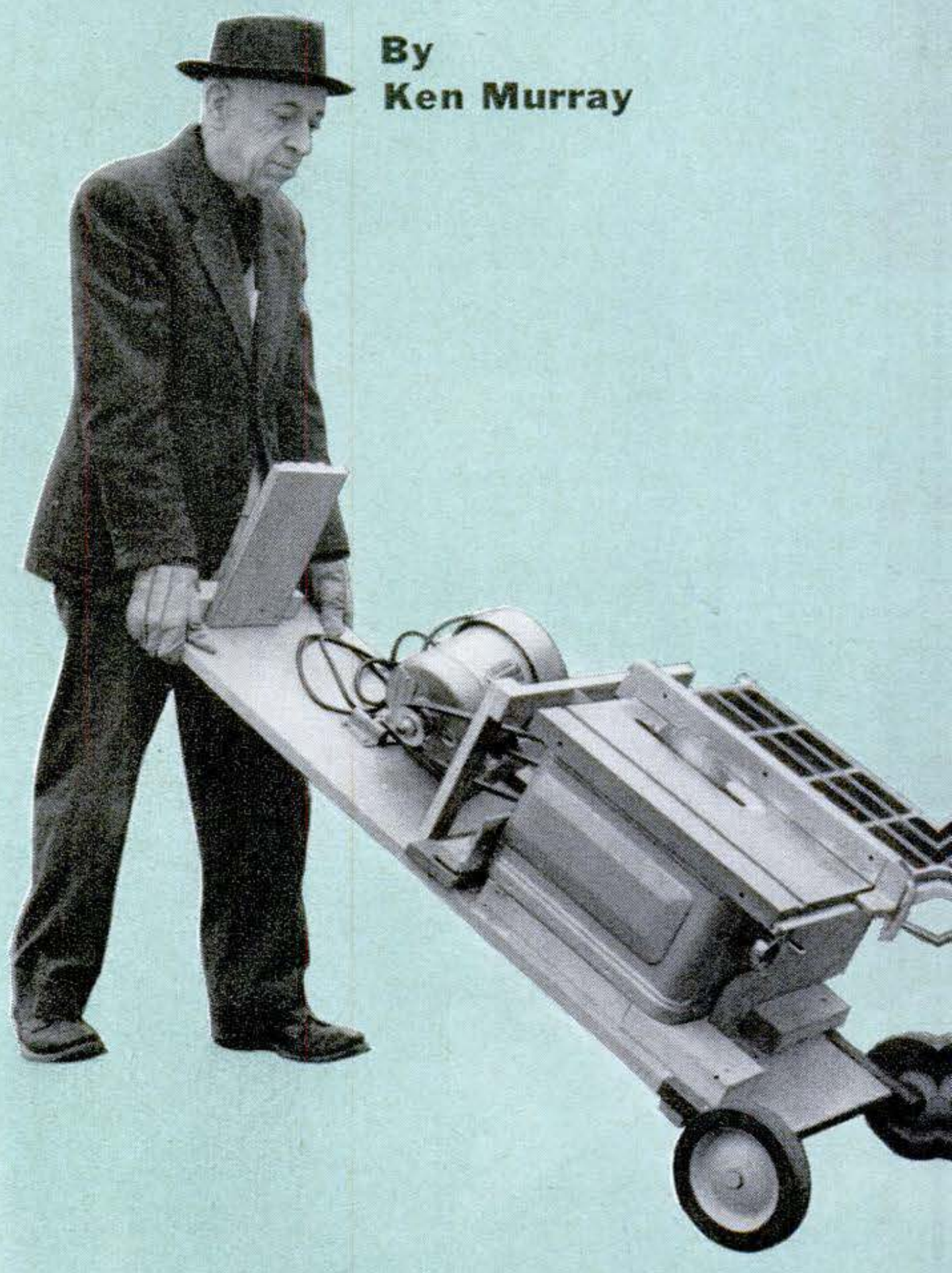


Quick C-Ring Replacement

HERE'S a home fix when you break or lose a C ring that fits around shaft notches to hold together the parts of an appliance such as a vacuum cleaner. Use "one turn" cut from a screen-door coil spring. Cut the spring wire—or notch with a file and break it—to get slightly less than a turn. —*M. Fahnestock, Pittsburgh.*

Saw-on-Wheels Rolls to the Job

By Ken Murray



PUSHED LIKE A WHEELBARROW, this wheeled table saw can be moved easily out of the shop and into the yard for outdoor work. It also can be rolled up a ramp into the back of a truck or station wagon, or can be taken anywhere in the house from basement to attic. When not in use, the saw is low enough to store under a workbench or table, saving space. The portable rig was devised to handle large work and on-the-spot jobs that can't be easily taken to the shop. How the saw goes into operation is shown in the series of photos at the right.

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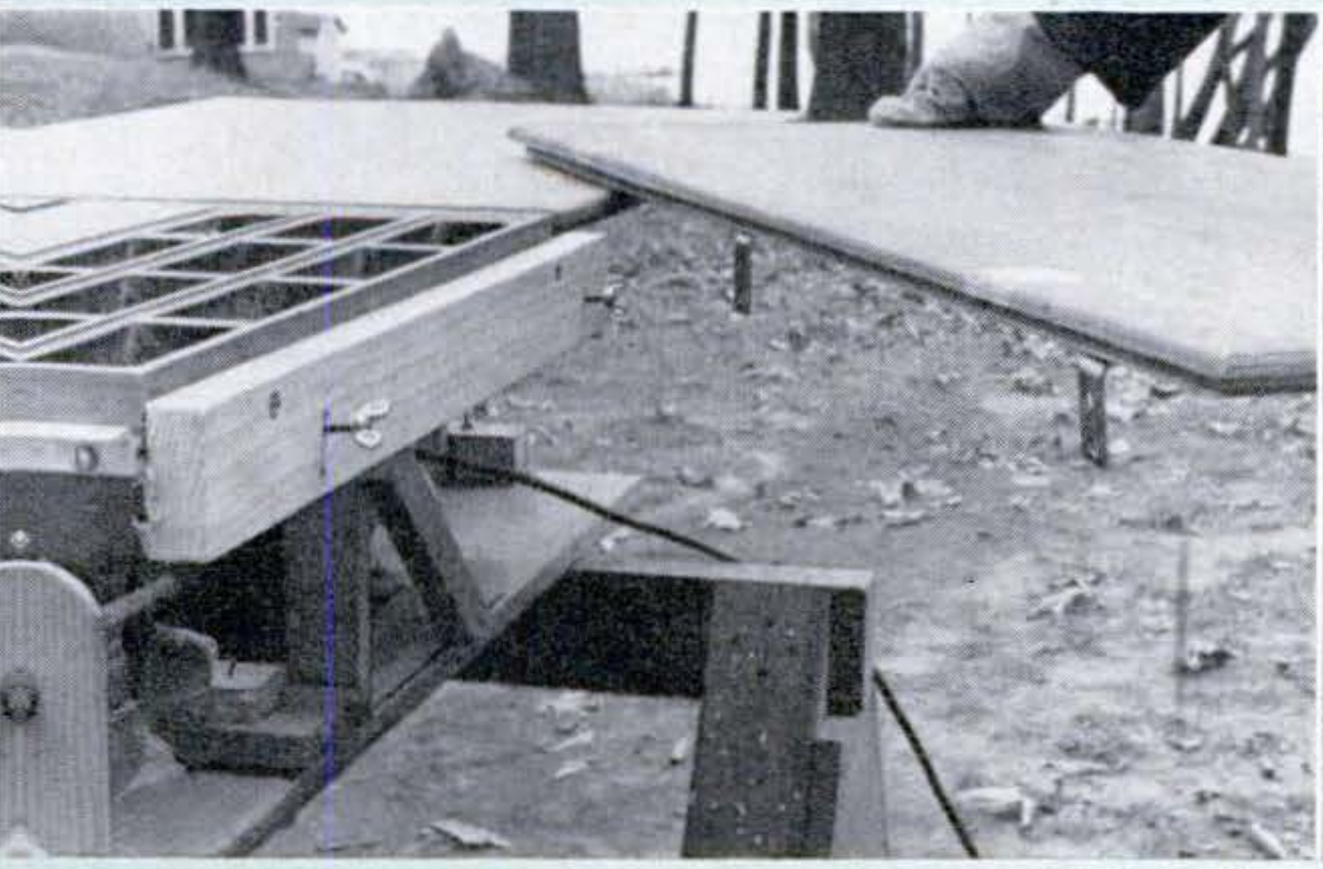
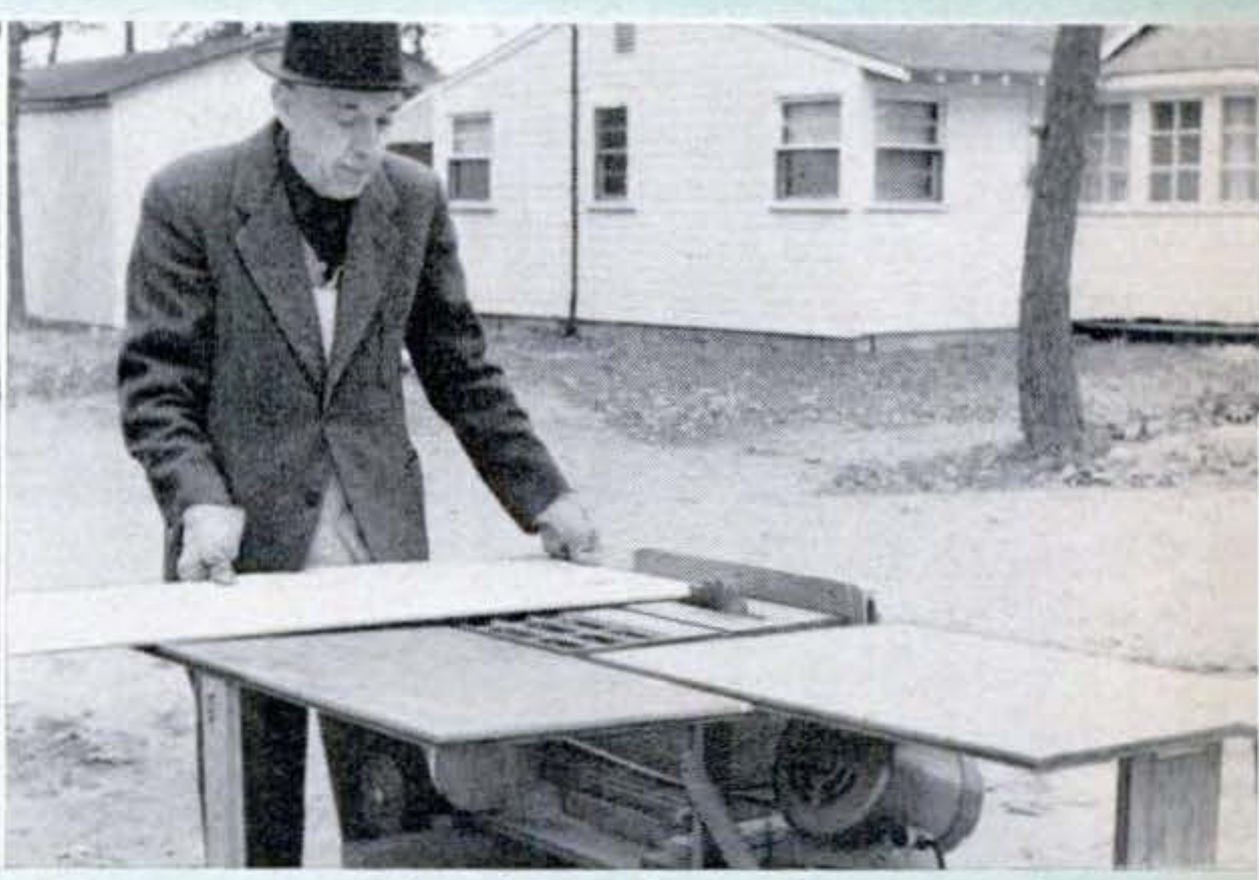
SAW IS QUICKLY SET UP on two sawhorses to raise it to working height. Trick of backing it over first horse and levering it up minimizes the weight and makes the rig easy to lift.

TABLE EXTENSION takes only a second to attach with a loose-pin hinge to an upright at the end of the base. The extension then swings down and rests on a rail at the end of the saw.

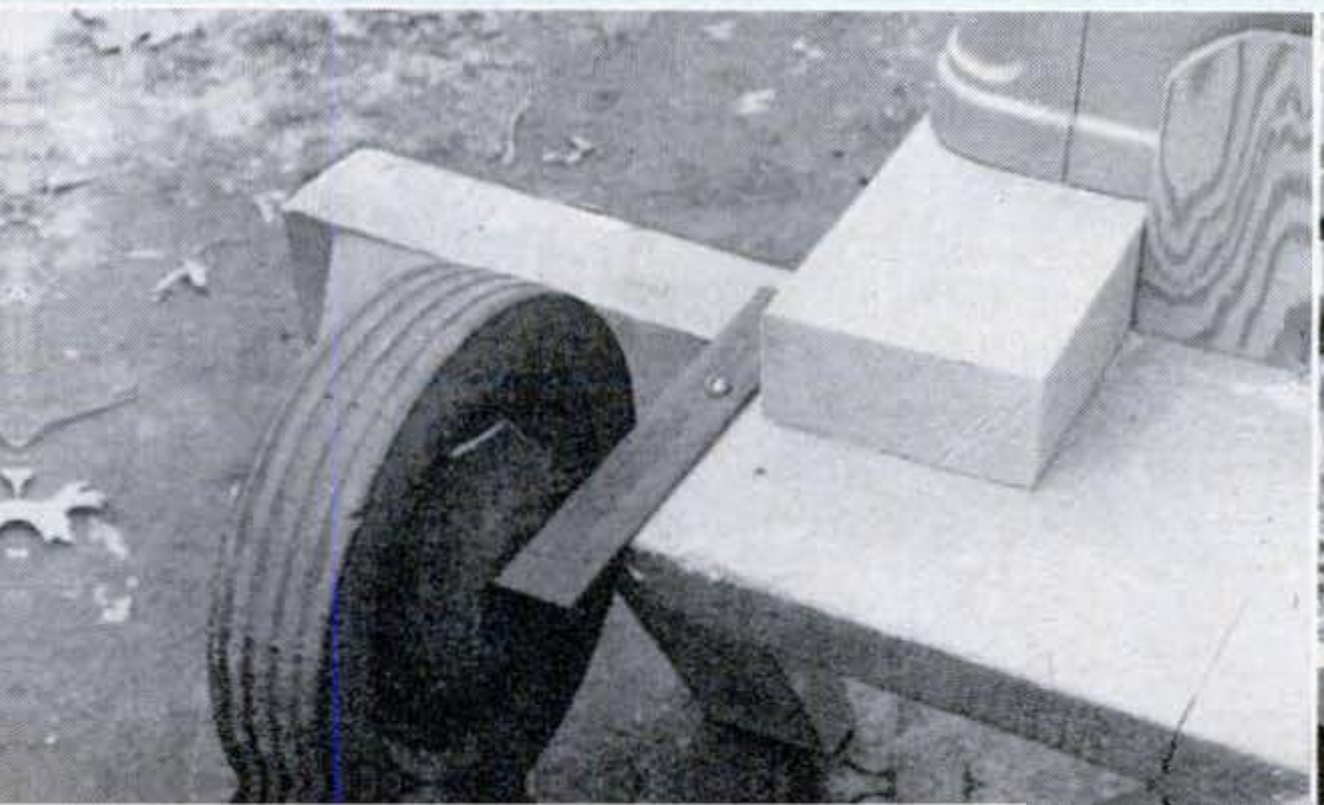


NEXT COMES A SECOND EXTENSION, which hooks onto the side of the saw. Angle-iron brackets screwed to the table slip over bolts on the saw and are quickly clamped with wingnuts.

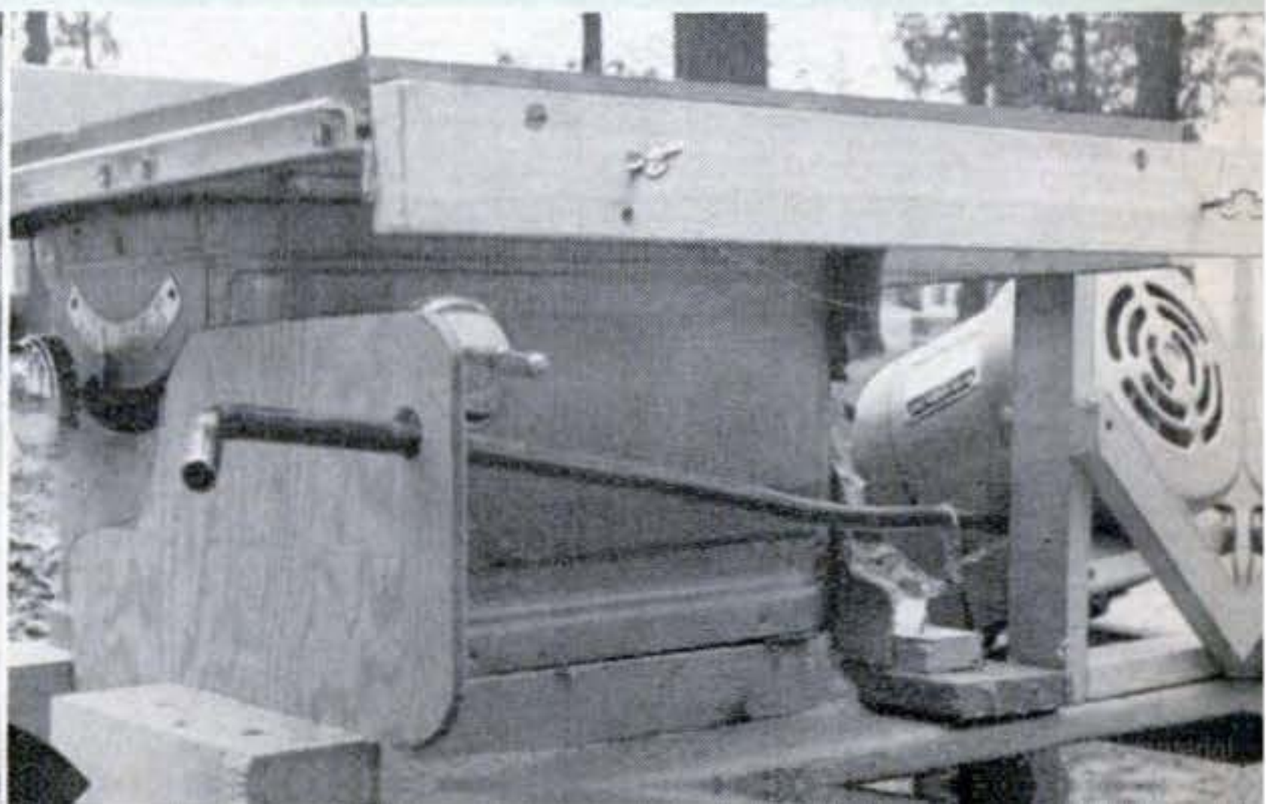


READY TO GO only minutes later, the saw easily handles boards that are often too long or wide for maneuvering in cramped indoor spaces. Side table rests on a removable outer leg.

WHEELS ARE BOLTED to short lengths of steel angle screwed to front edge of base. They are the inexpensive solid-tire type usually sold as replacements for wheelbarrow wheels.



A TWIST OF THIS CONTROL ARM turns the motor on or off from the operator's side. It's a length of copper tubing with a hole drilled near the end to hook over the toggle of the switch.

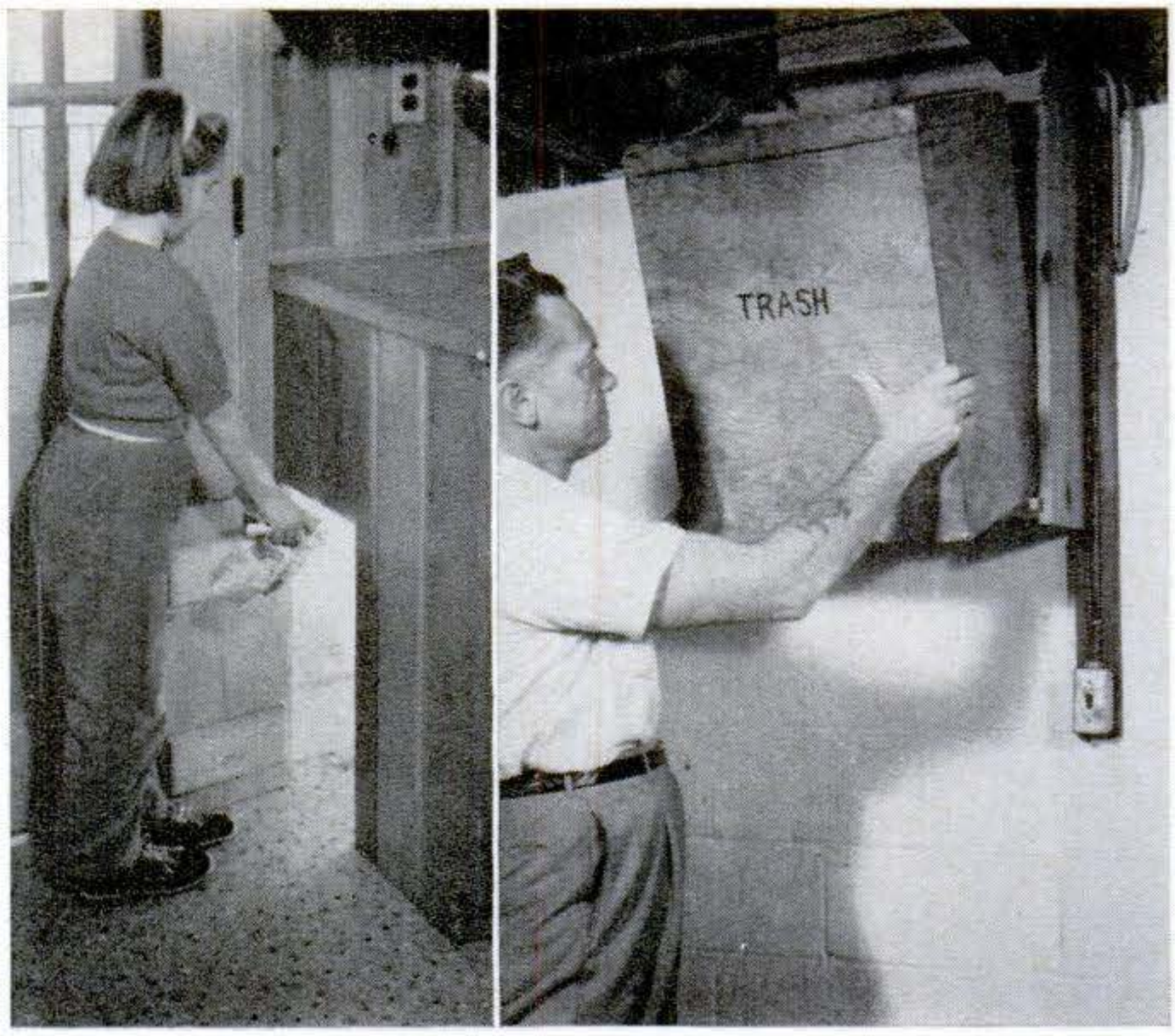


Short Cuts and Tips

FROM PS READERS

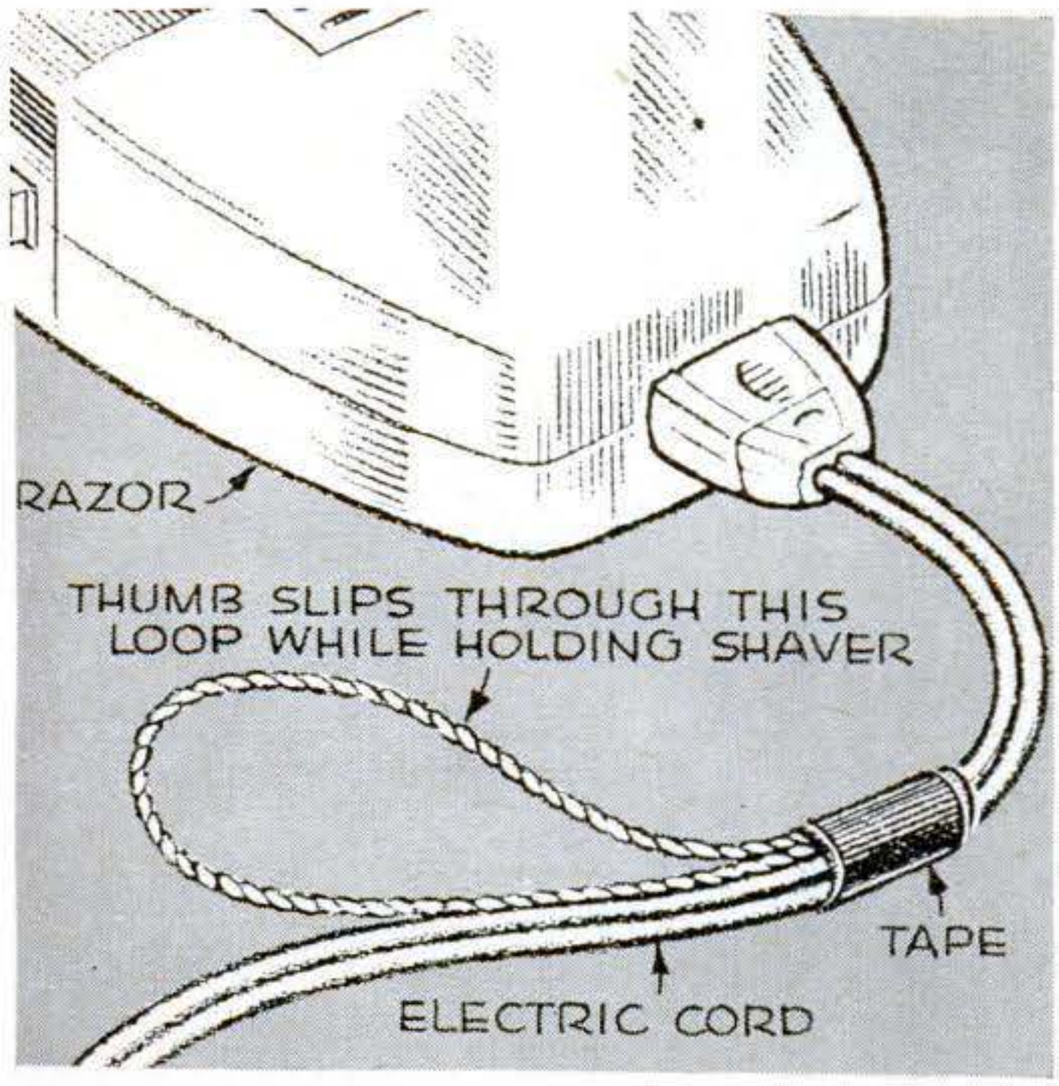
Built-In Unit for Trash Disposal

WHEN I built my new home, I left a small section of the kitchen floor open where the end of a cabinet would go. Then I put an end door in the cabinet. Now we throw our trash down the hole into a removable box, where it collects for burning in my basement fireplace.—*Curtis Cross, Baltimore.*



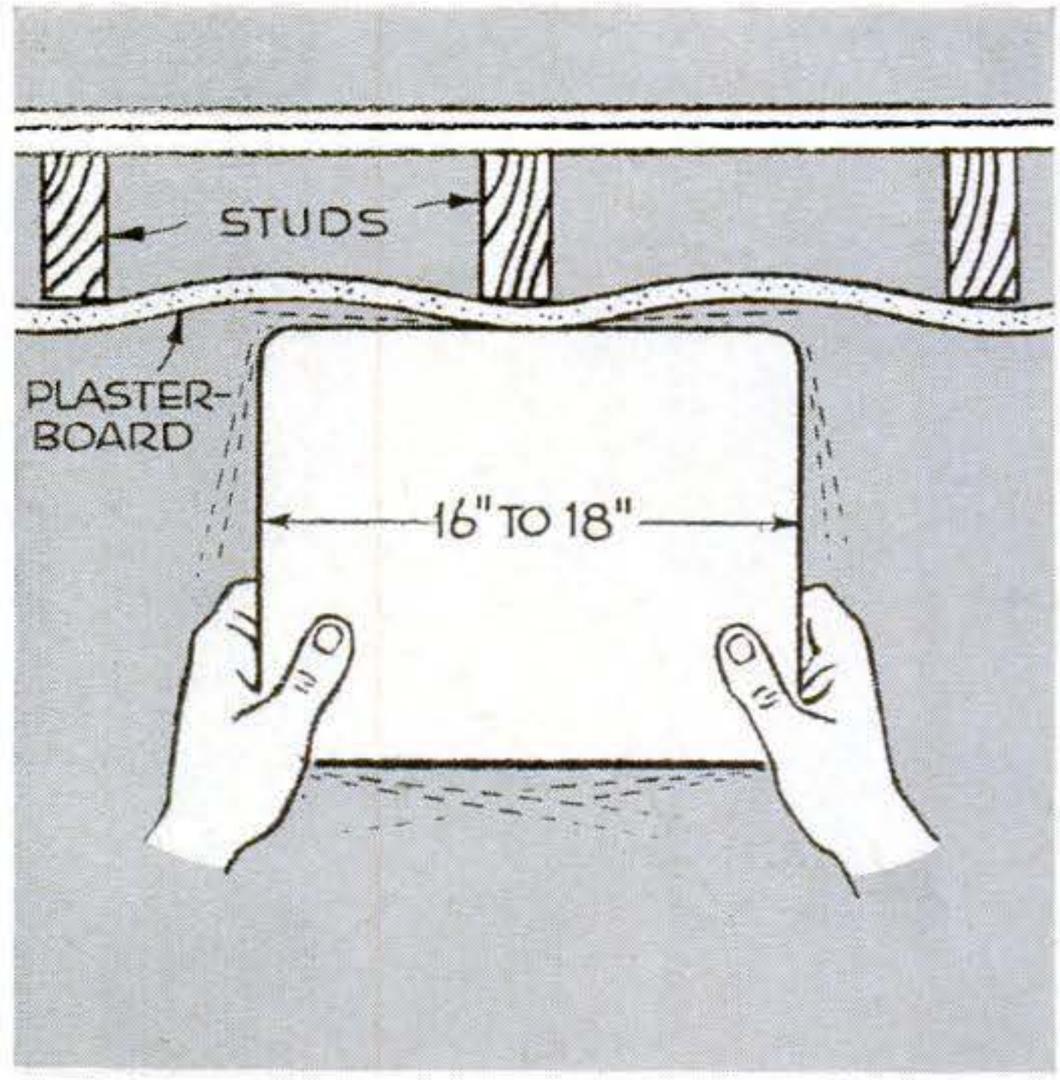
▶▶▶PREVENT chair legs from scratching your floors by using small rubber faucet washers as cushions. To attach them, countersink ¾″ flathead screws that are slightly larger than the washer holes.—*Eugene Boehm, Durand, Wis.*

▶▶▶I KEEP one light in my basement shop on a circuit separate from my power tools. If a fuse is blown by a stalling power saw or some other overloaded tool, I don't have to grope around in the dark. —*D. E. Roetman, Dayton, Ohio.*



Safety Loop for Razor

I WAS stuck with a $10 repair bill when my electric razor slipped out of my hand and hit the washbowl. No more. I taped a loop of string around the cord about 6″ from where it plugs into the razor. Now, with my thumb inside the loop while shaving, I have the razor caught if it slips.—*James Coe, Glendale, Cal.*



Board to Find Studs

A SQUARE of plywood can be used to find the studs in wallboard-covered walls. Use a 16″ square with rounded corners. Place one edge of the square against the wall, then rock the board back and forth from left to right. Where the wobble is most pronounced, the board will be centered on a stud.—*Norm Jacky, Seattle.*

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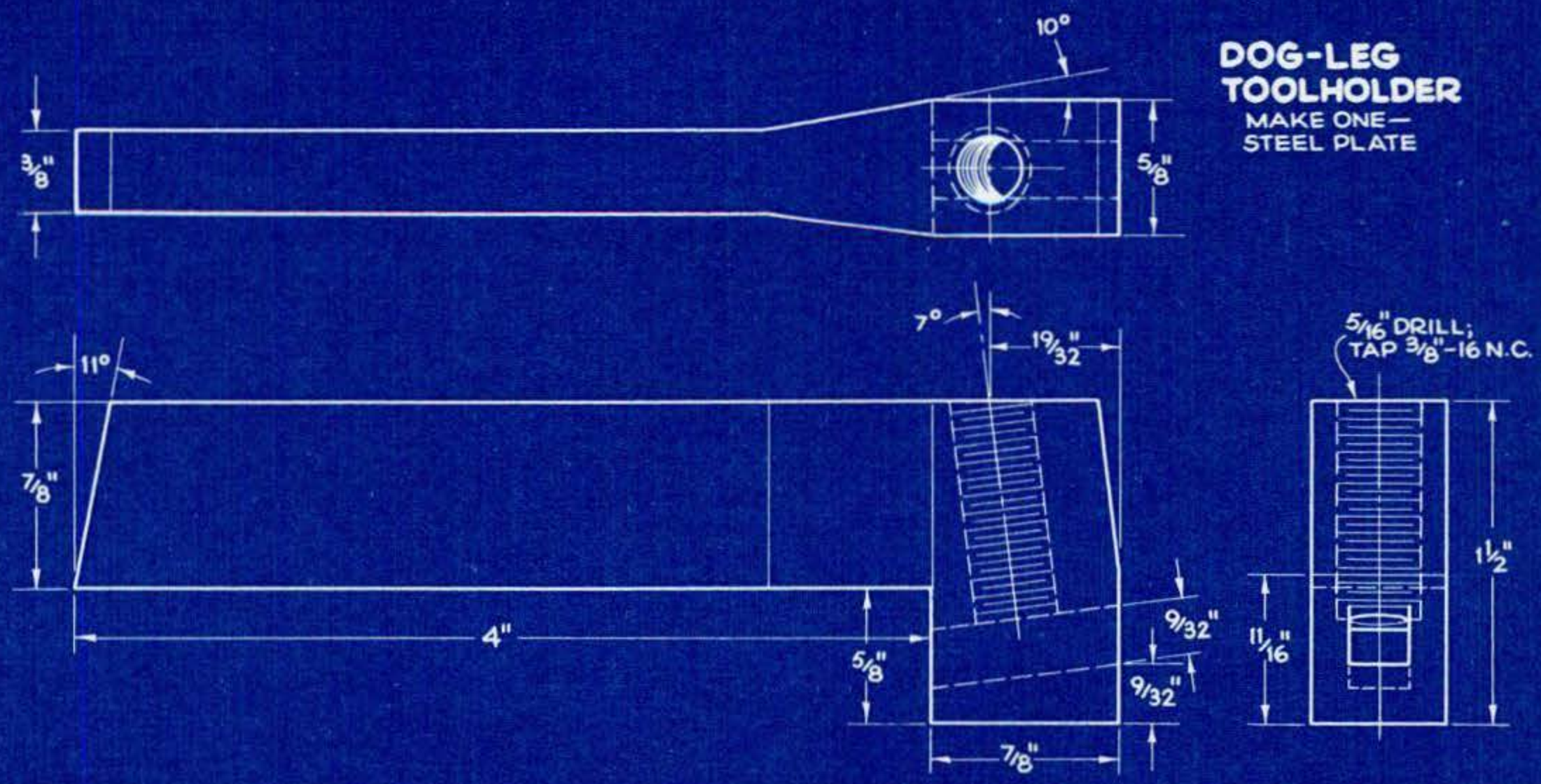
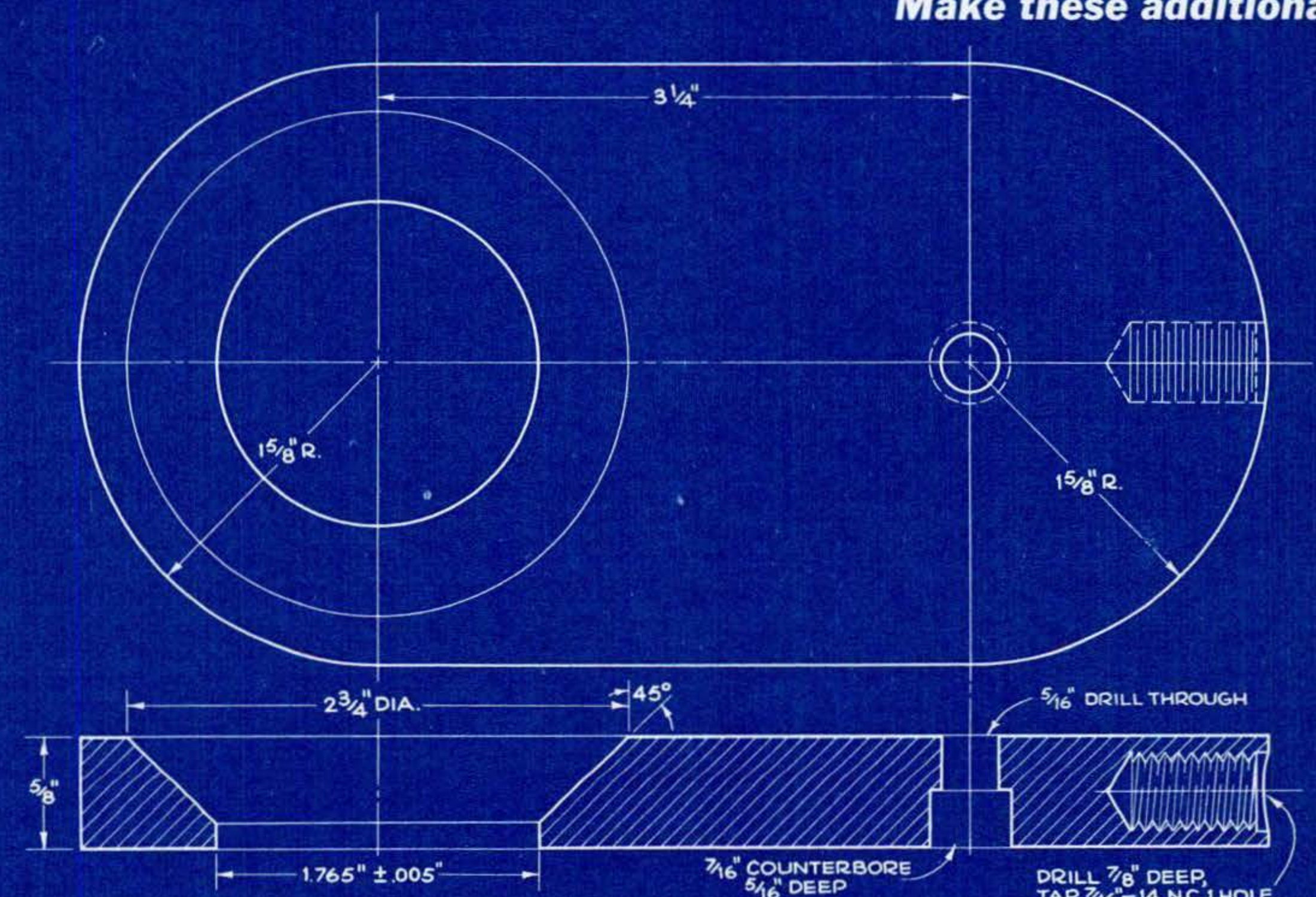
These parts are the same for both

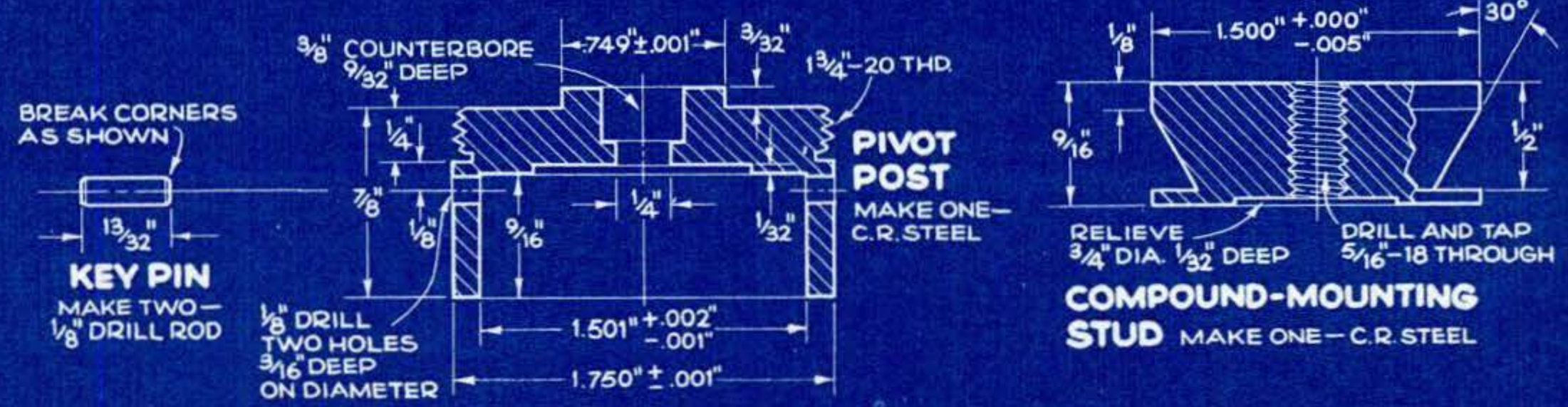


DOG-LEG TOOLHOLDER
MAKE ONE—
STEEL PLATE

Make these additional



MOUNTING PLATE MAKE ONE — 5/8" GROUND TOOLING STEEL, OR 3/4" H.R.S. OR C.R.S. PLATE FACED OFF TO 5/8" THICKNESS



KEY PIN
MAKE TWO—
1/8" DRILL ROD

PIVOT POST
MAKE ONE—
C.R. STEEL

COMPOUND-MOUNTING STUD MAKE ONE — C.R. STEEL

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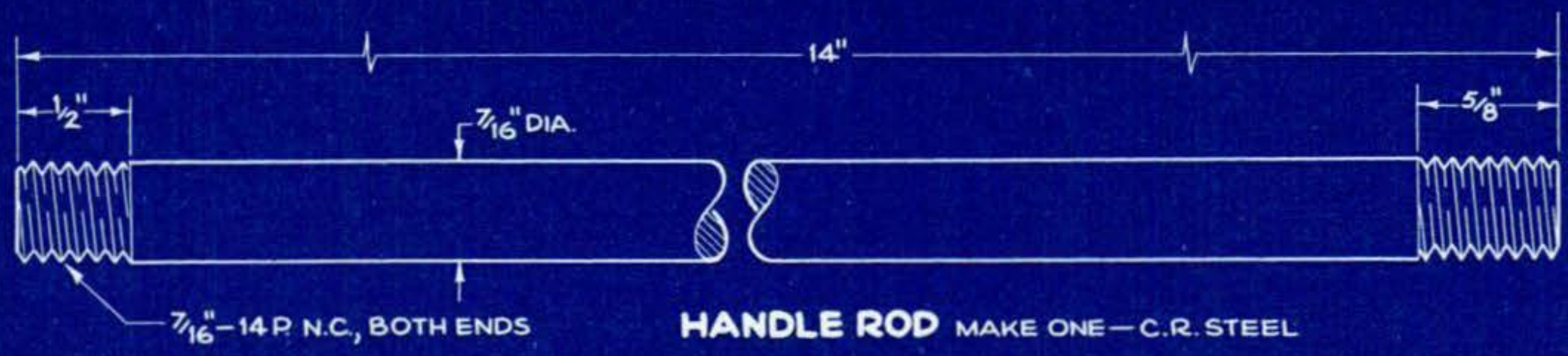
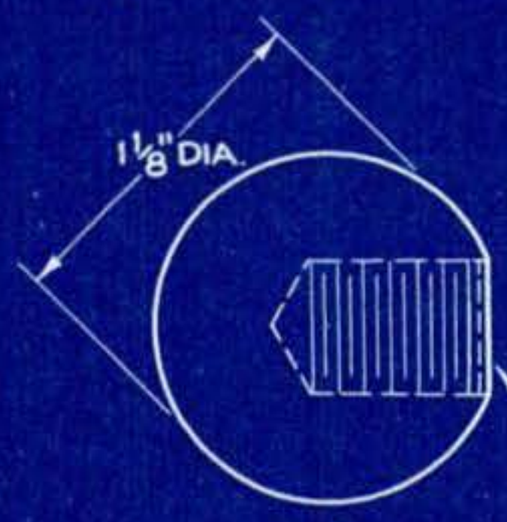
Atlas and South Bend lathes

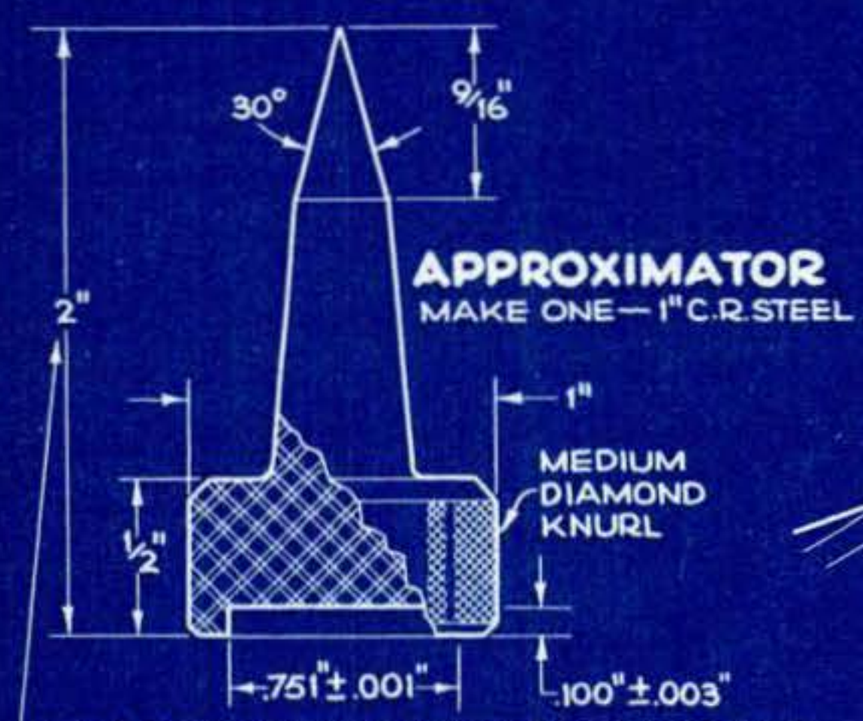


HANDLE ROD MAKE ONE—C.R. STEEL



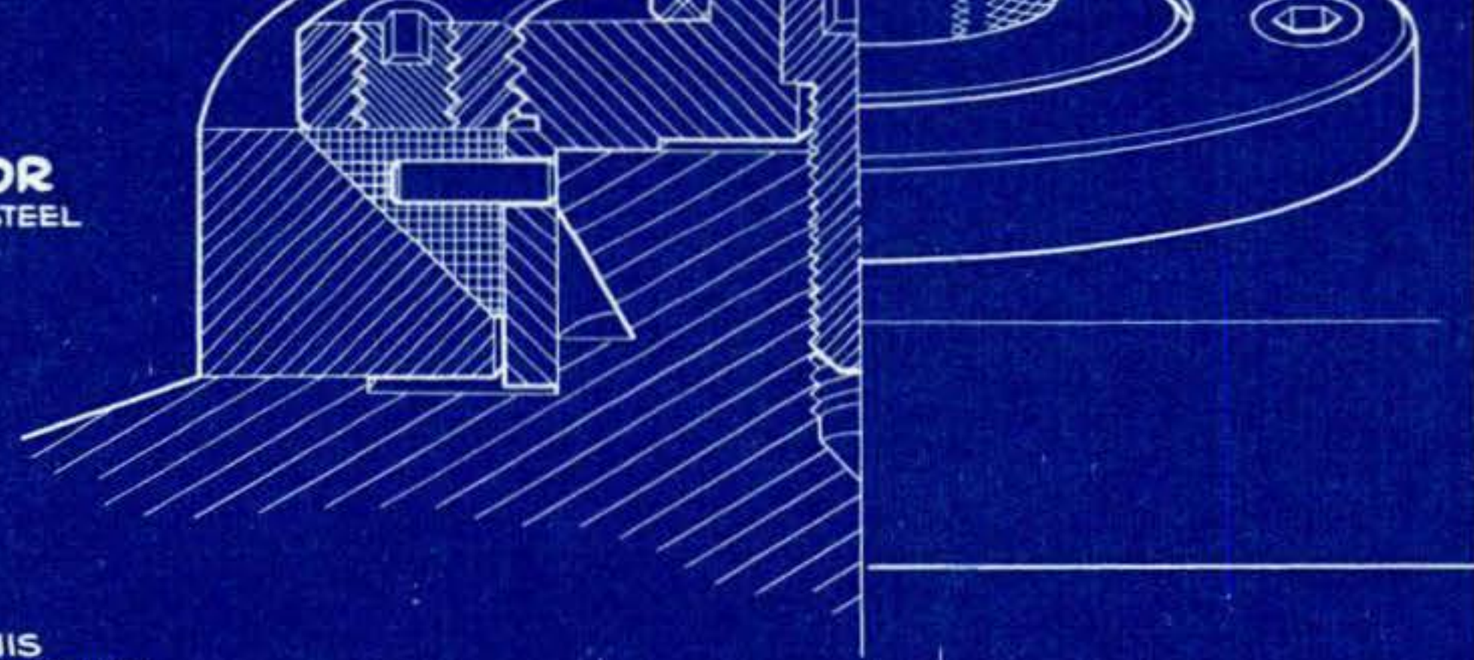
HANDLE BALL
MAKE ONE—BRASS

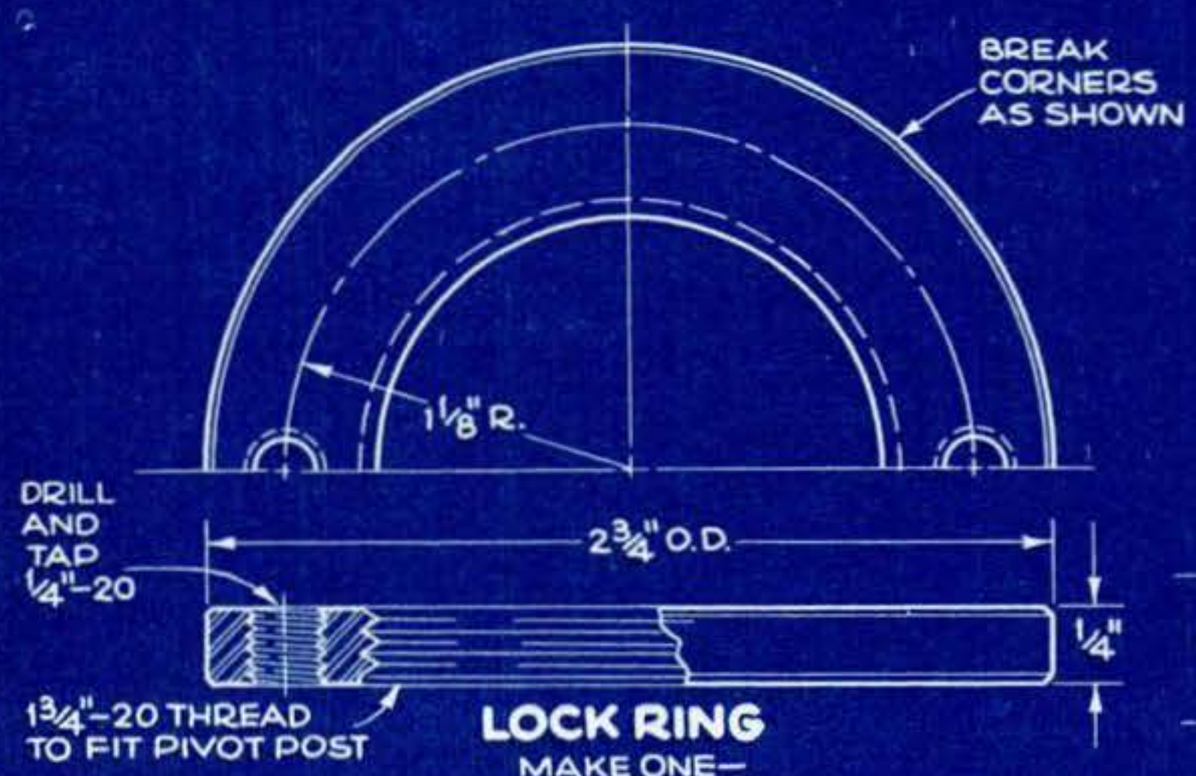
parts for an Atlas



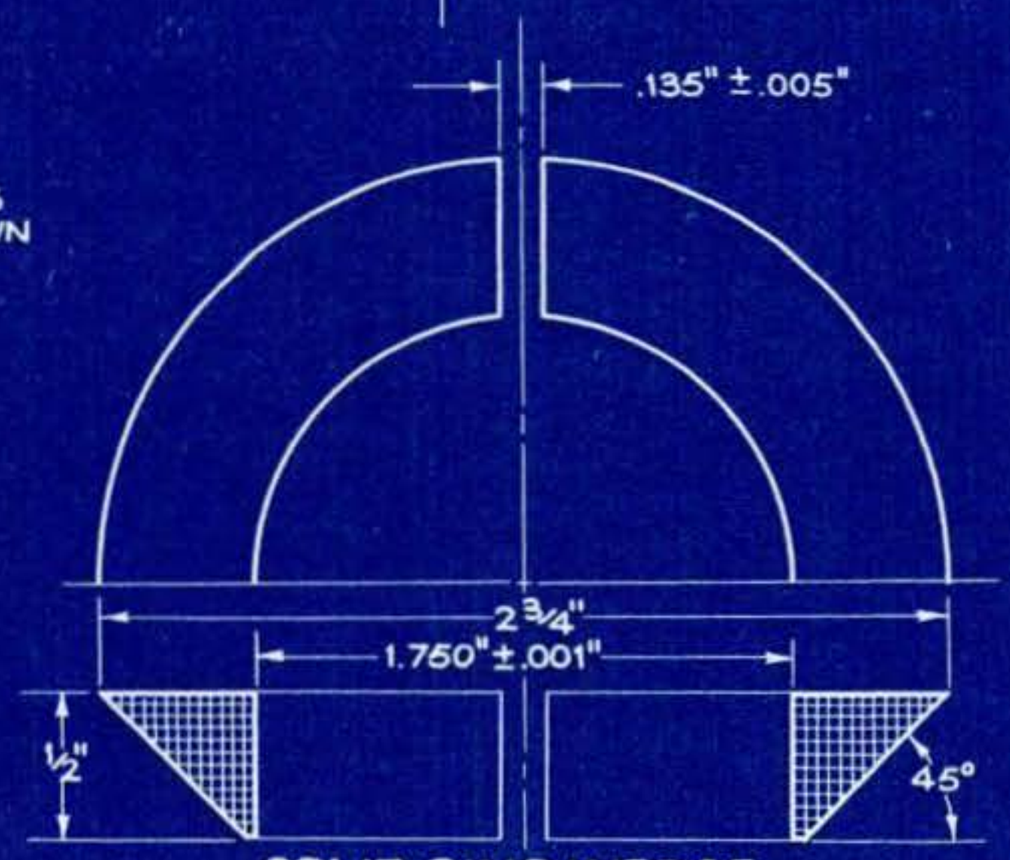
APPROXIMATOR
MAKE ONE—1" C.R. STEEL

THIS DIMENSION IS CRITICAL; MAKE THIS PART LAST TO SUIT LATHE AND BALL-TURNING ATTACHMENT AS COMPLETED





LOCK RING
MAKE ONE—
C.R. STEEL



SPLIT-RING WEDGE
MAKE TWO—TOBIN BRONZE OR HARD BRASS
(MAKE AS ONE PART, THEN SAW IN TWO)

POPULAR SCIENCE MONTHLY, 355 Lexington Ave., New York 17, N.Y.

BALL-TURNING ATTACHMENT FOR METAL-WORKING LATHE

DESIGNED BY: Joe Whitehill

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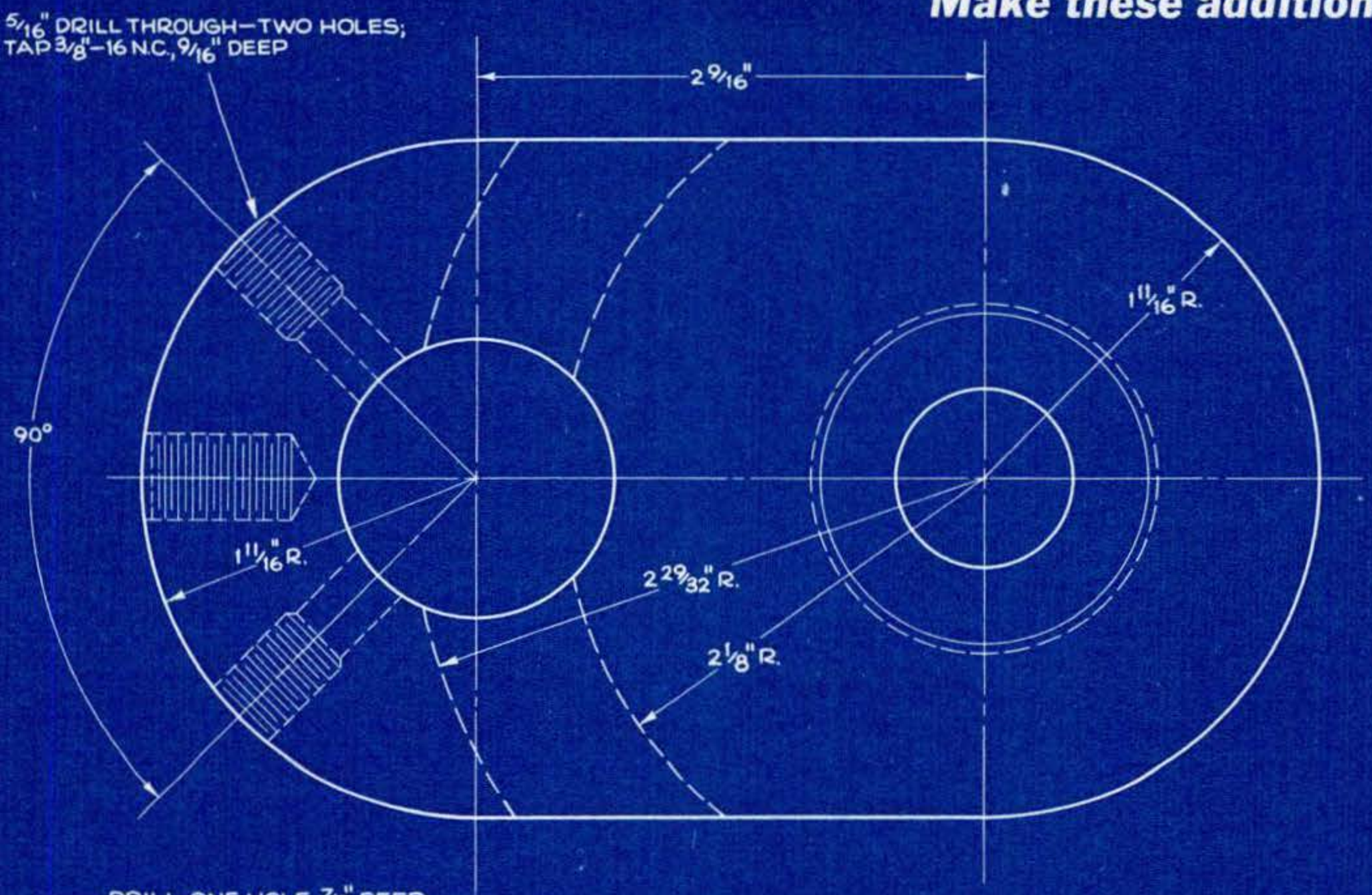
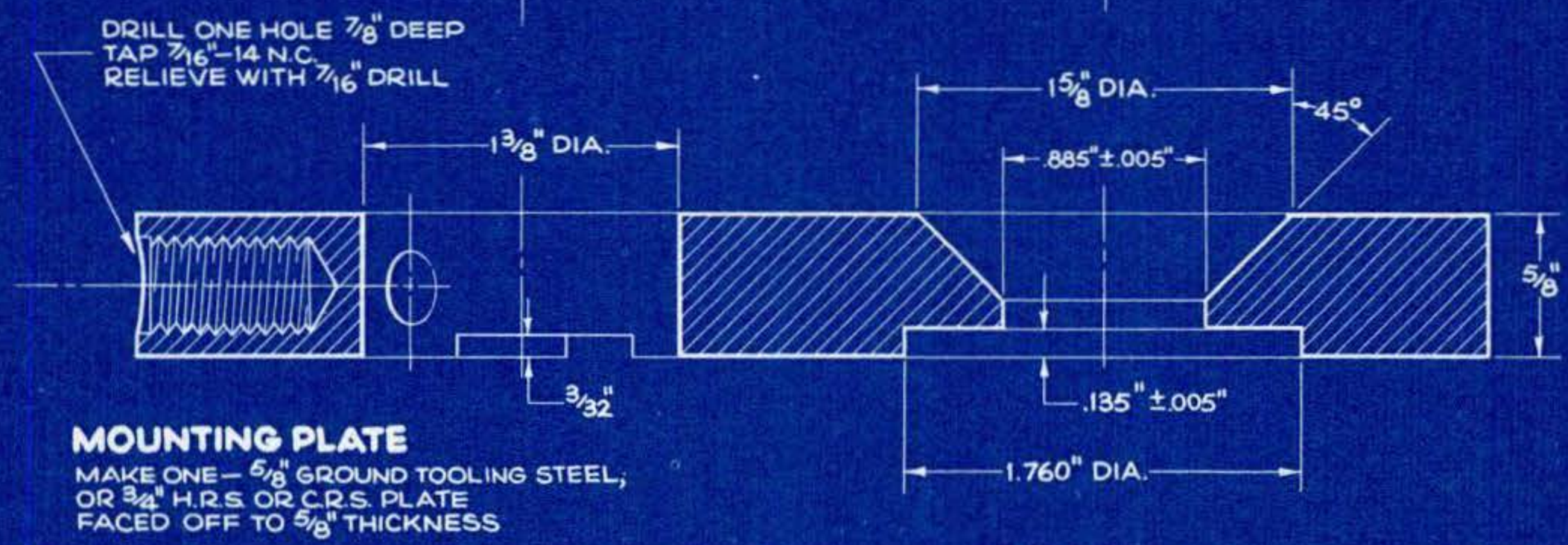
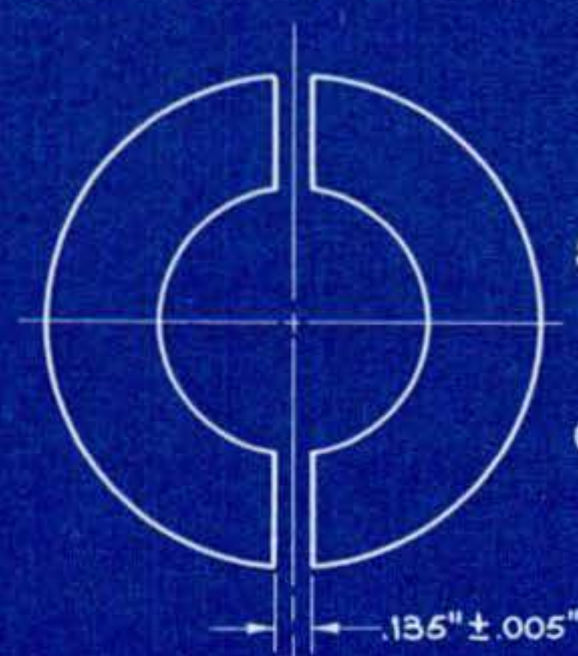
Make these additional p





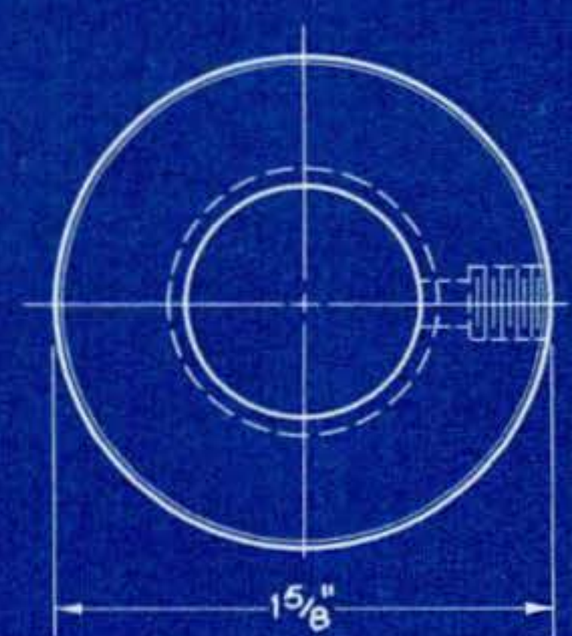
MOUNTING PLATE

MAKE ONE— 5/8" GROUND TOOLING STEEL;
OR 3/4" H.R.S. OR C.R.S. PLATE
FACED OFF TO 5/8" THICKNESS



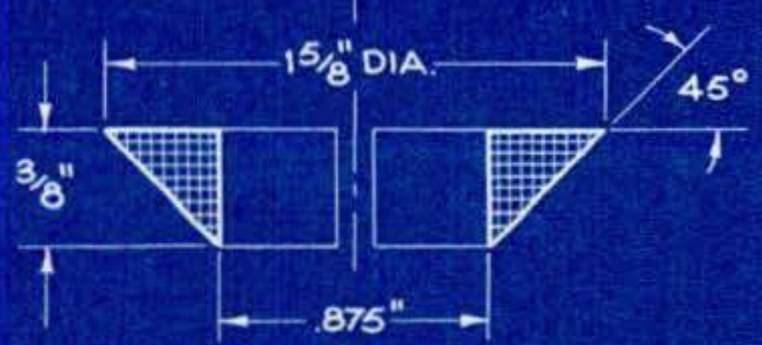
SPLIT-RING WEDGE

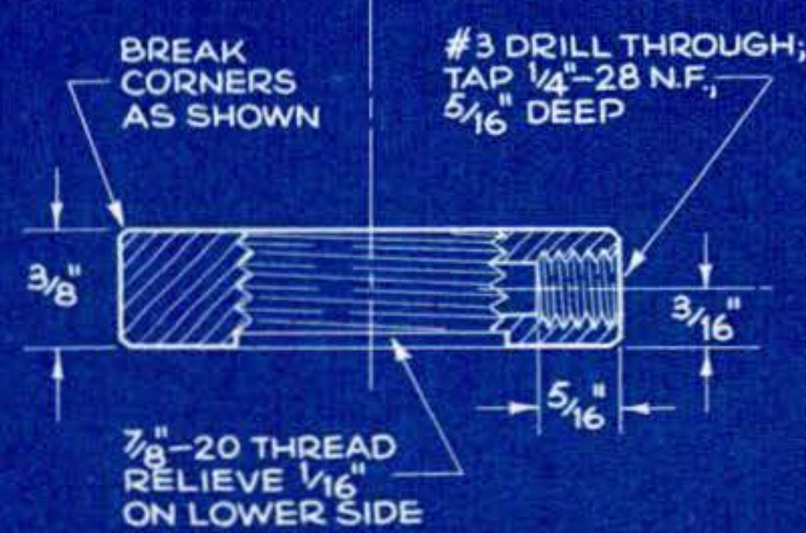
MAKE TWO—
TOBIN BRONZE
OR HARD BRASS
(MAKE AS ONE PART,
THEN SAW IN TWO)



LOCK RING

MAKE ONE—
C.R. STEEL





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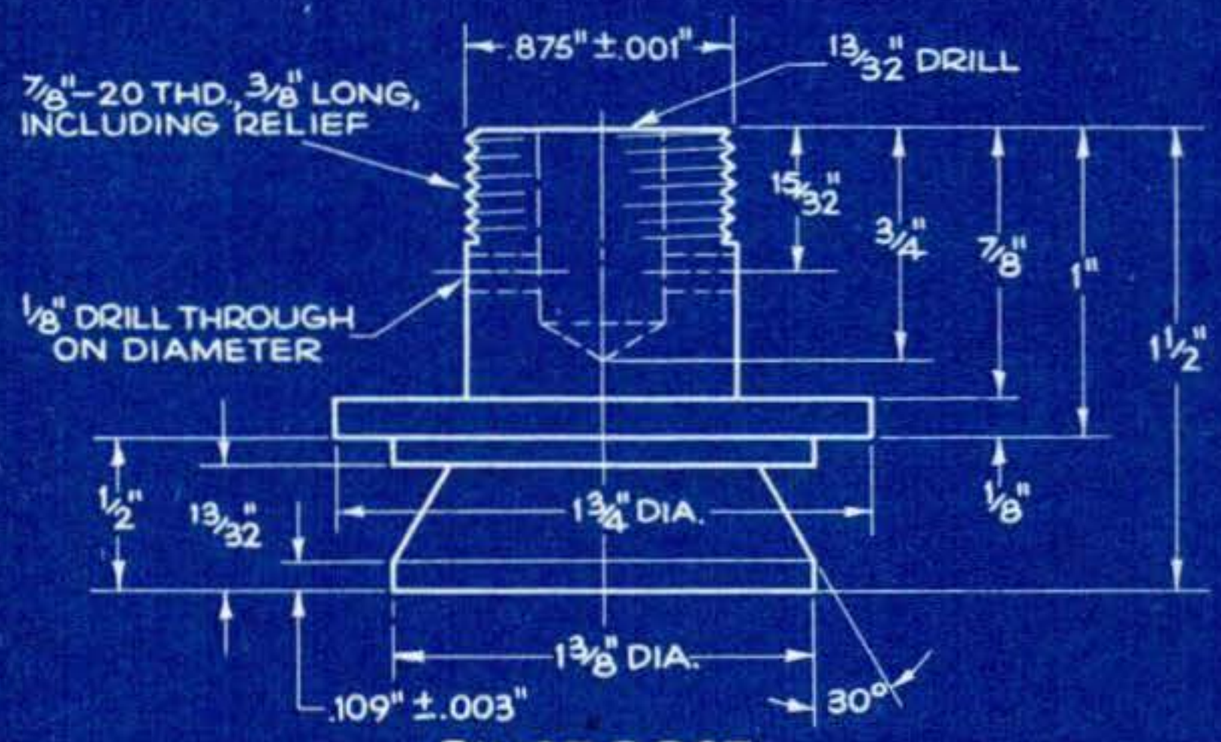
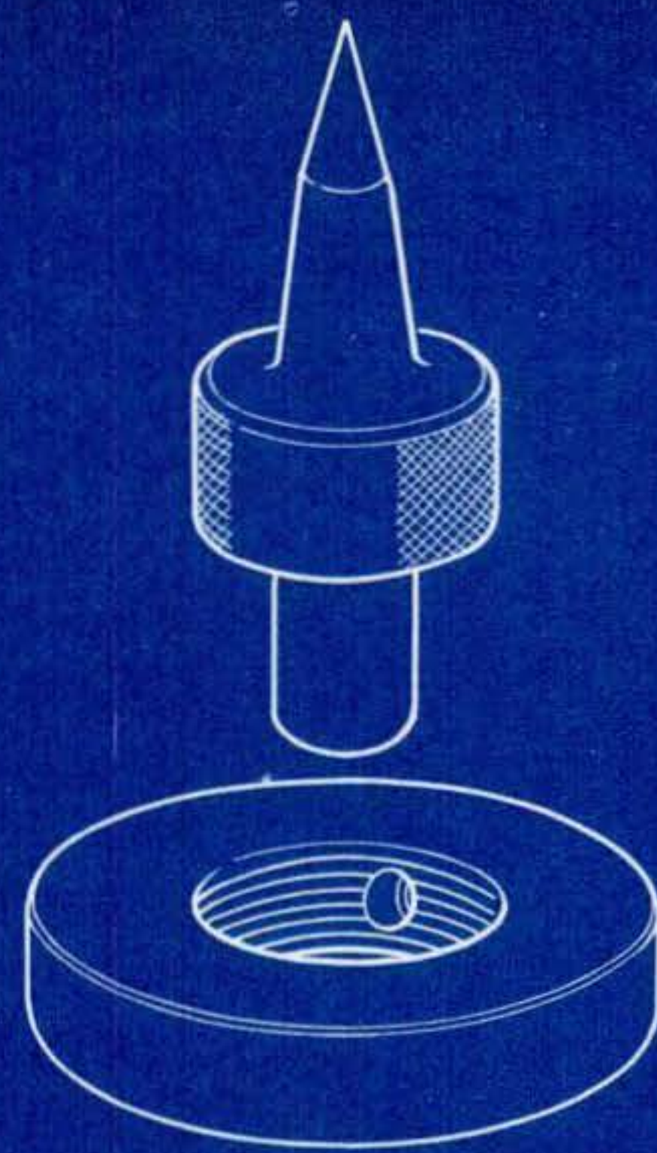
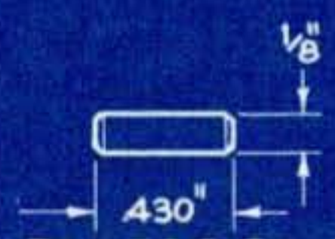
arts for a South Bend

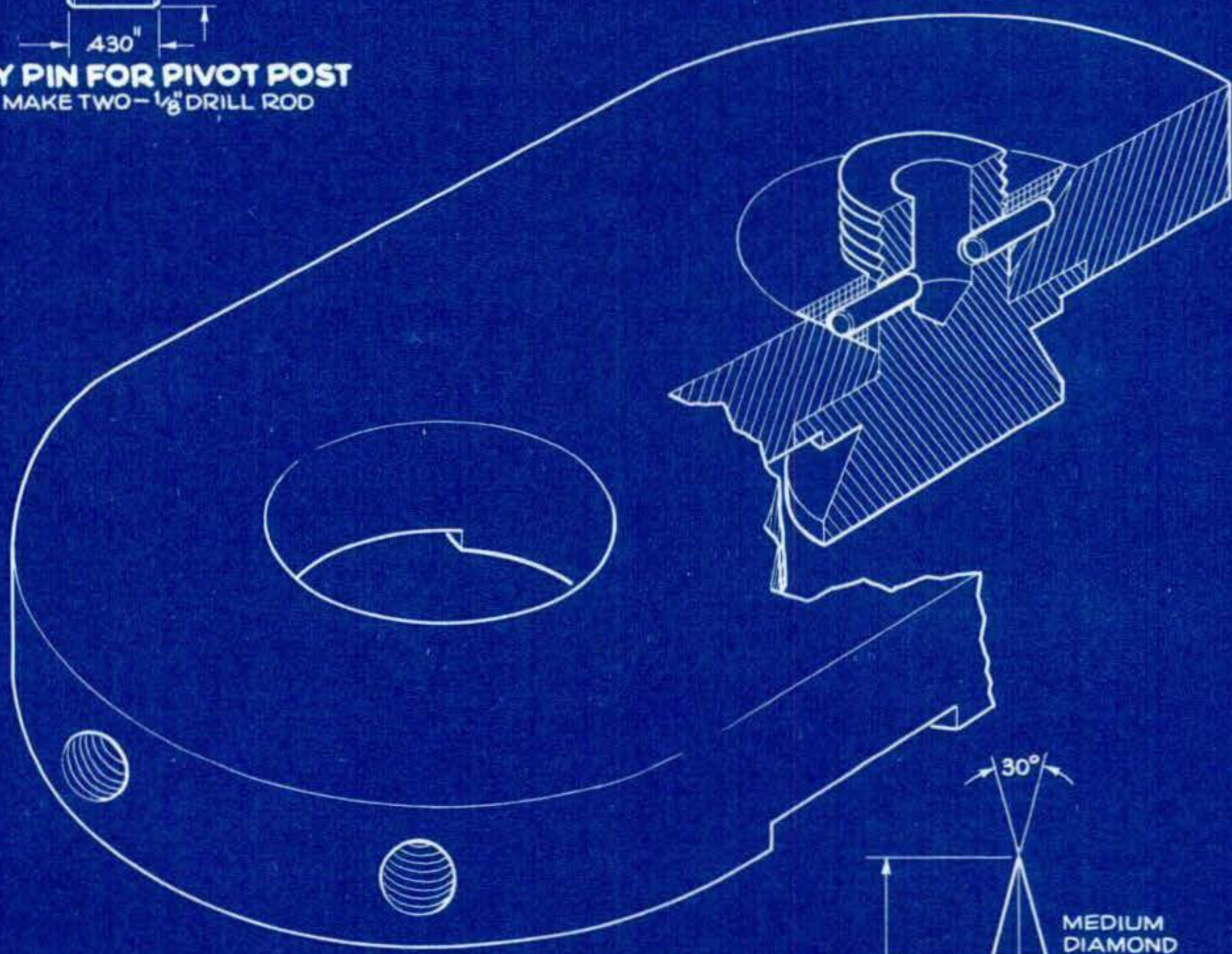


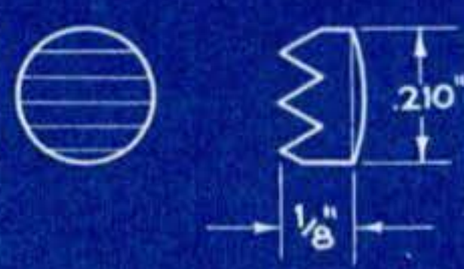
PIVOT POST
MAKE ONE—C.R. STEEL





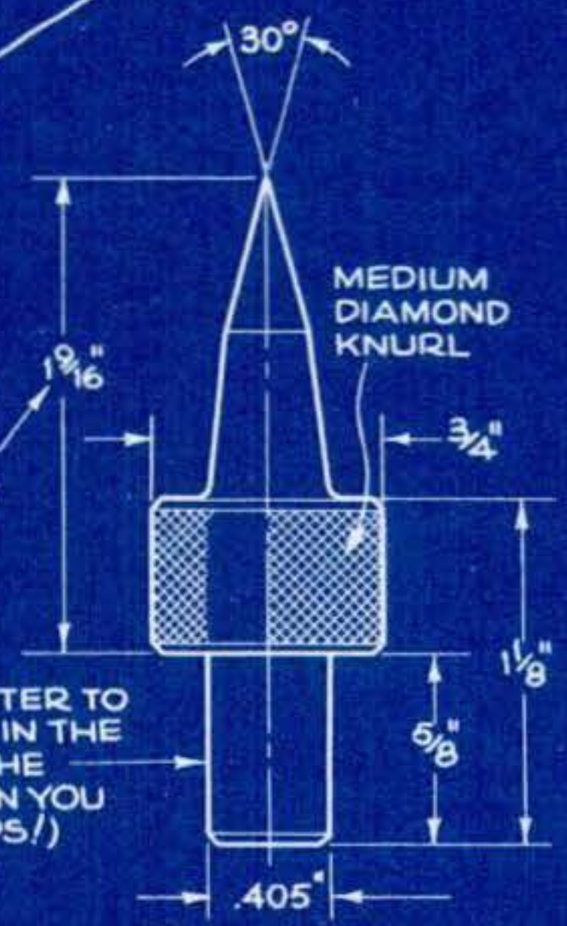
KEY PIN FOR PIVOT POST
MAKE TWO—1/8" DRILL ROD





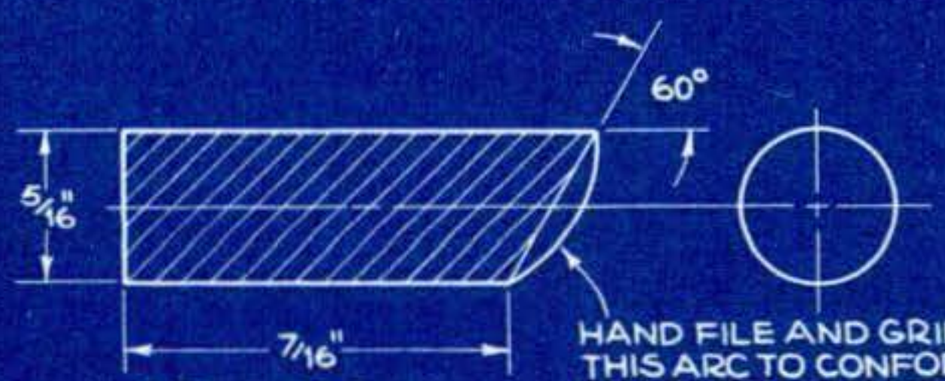
FRICTION BUTTON
MAKE ONE—BRONZE (SEE TEXT)

THIS DIMENSION IS CRITICAL; MAKE THIS PART LAST TO SUIT LATHE AND BALL-TURNING ATTACHMENT AS COMPLETED



TURN THIS DIAMETER TO BE A "POPGUN" FIT IN THE 13/32" DIA. HOLE IN THE PIVOT POST (WHEN YOU PULL IT OUT, IT POPS!)

APPROXIMATOR
MAKE ONE—3/4" C.R. STEEL



HAND FILE AND GRIND THIS ARC TO CONFORM TO CONE TAPER OF COMPOUND-MOUNTING POST

LOCKING PIN
MAKE TWO—BRONZE

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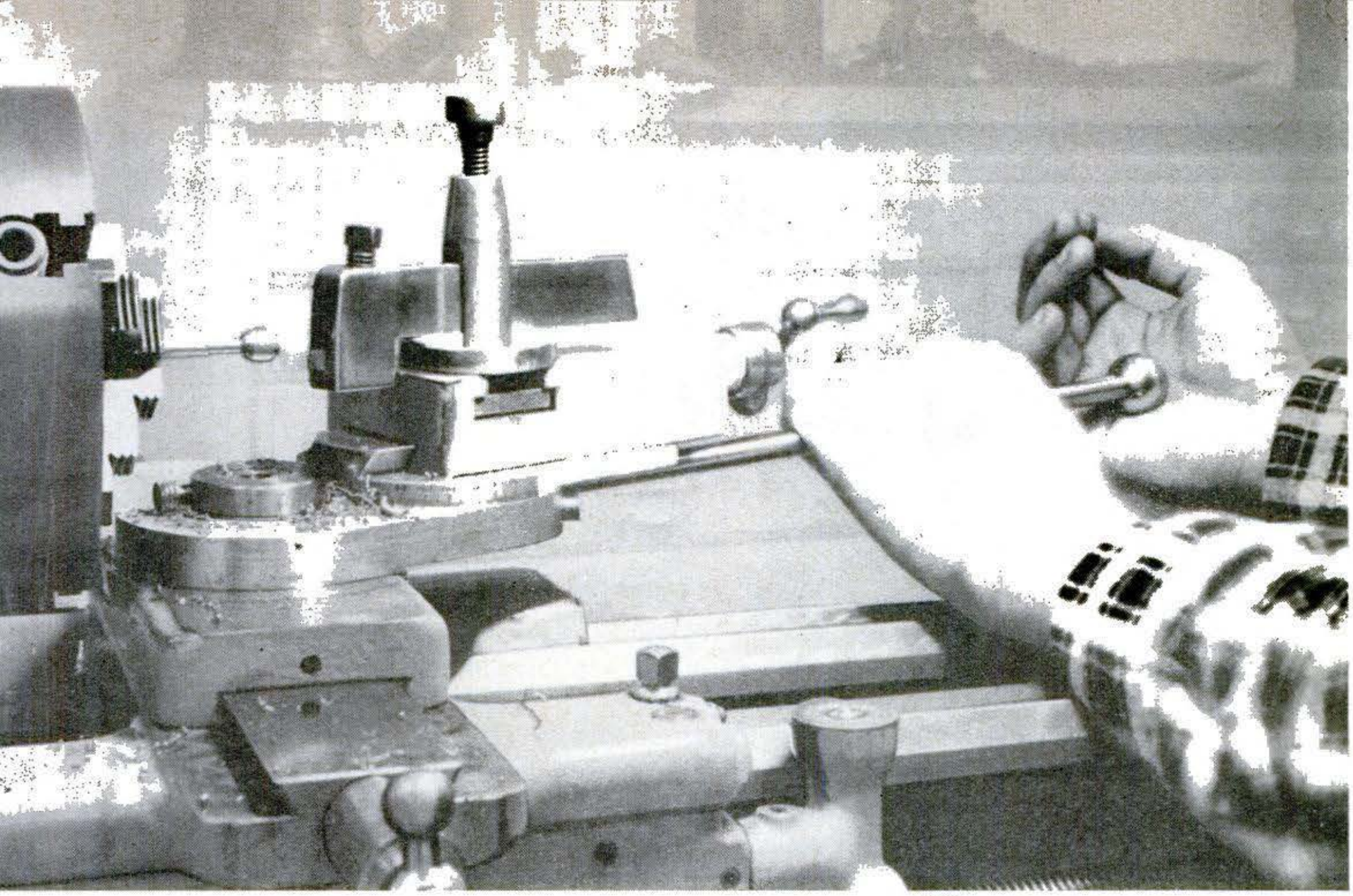

HOW TO MAKE A Ball-Turning Attachment for a Lathe

...and here's a free blueprint to help you

By Joseph Whitehill

THIS attachment will widen the scope of the thoughtful machinist. Many designs and techniques you have thought impossible can become standard practice when you gain familiarity with the tool.

You can turn balls and sockets up to three inches in diameter, each precisely spherical to within half a thousandth of an inch. A unique pivot bearing that prevents all play, both vertical and radial, is the secret of its accuracy and versatility. Full use of the compound is retained for micrometer setting of depth of cut and final radius. True spherical surfaces are rapidly produced by swiveling the tool about an accurately held, fixed pivot center.

The trueness of the pivot bearing is due to the action of two split-ring wedges. The pivot post is locked fast to the cross slide by the same means that ordinarily holds the compound. The mounting plate fits over the post but does not touch it.

CONTINUED

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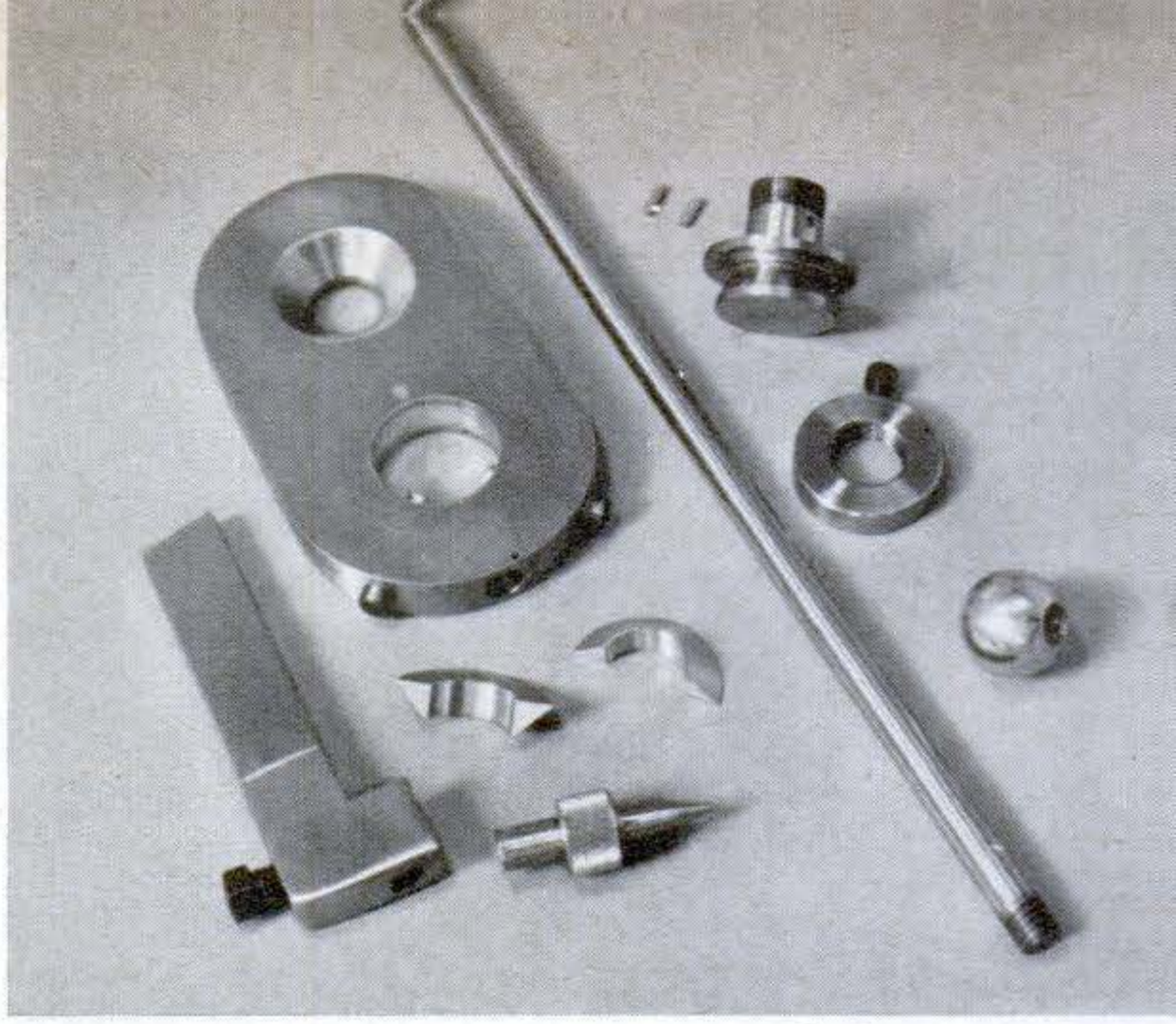
These are the finished parts for the ball-turning attachment

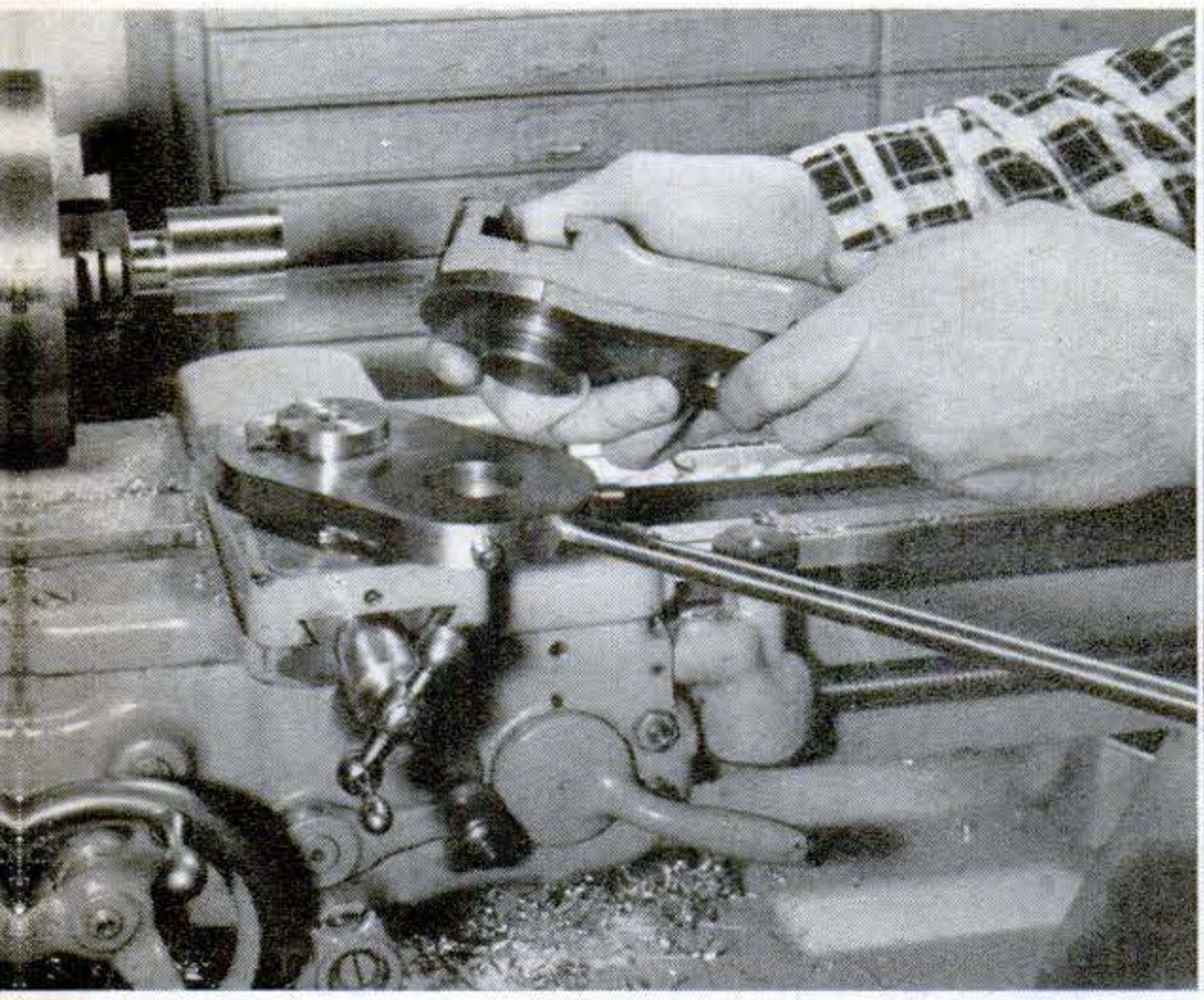
The split-ring wedges fit around the post and bear on the tapered seat in the mounting plate. When you tighten the lock ring, the pressure forces the wedges not only against the tapered seat in the mounting plate, but also, by translation, in against the pivot post. Thus excellent concentricity is assured, there is absolutely no play in the bearing, and smooth pivoting action is obtained without binding.

The basic design can be adapted to fit almost any engine lathe. Designs for the two most commonly used methods of

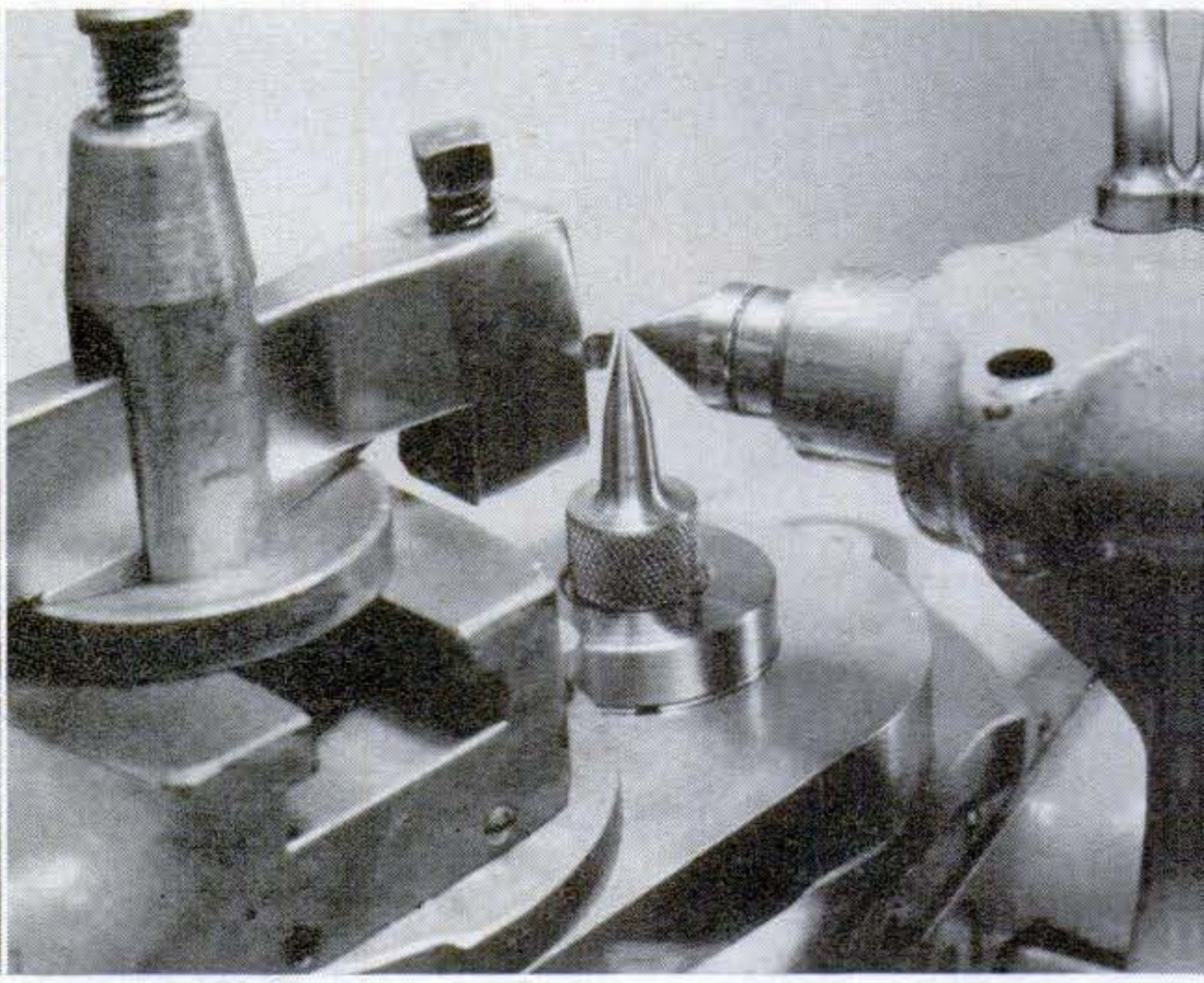


FINISHED PARTS to fit a South Bend lathe are ready for assembly. The arc channel shown in

Here are the steps necessary to set up the attachment

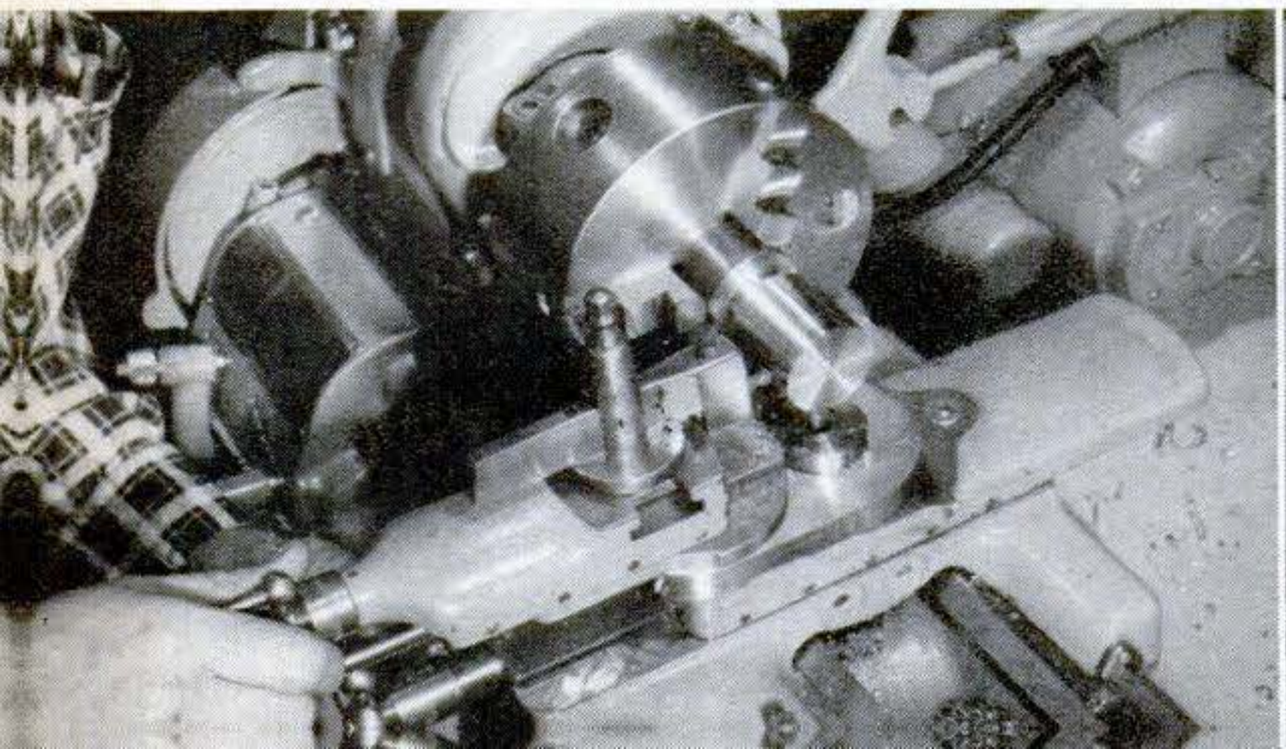


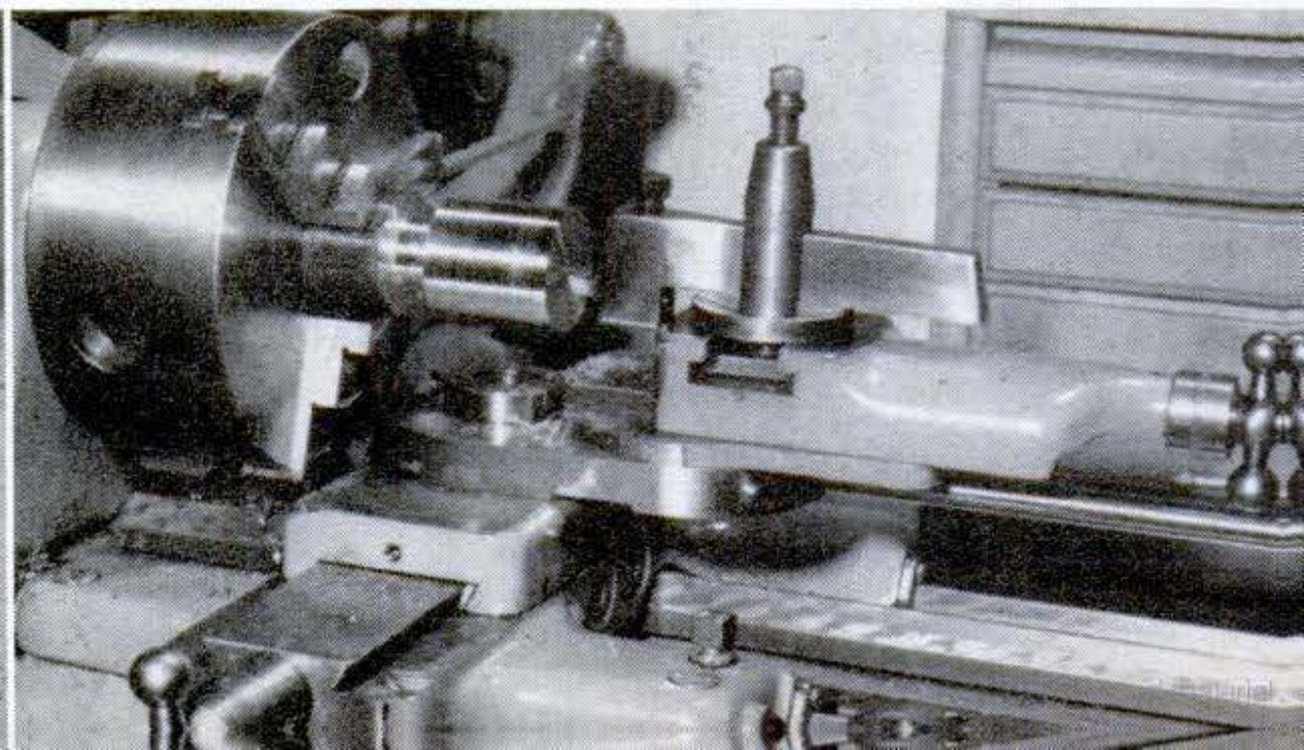
ASSEMBLE THE ATTACHMENT on the lathe with the compound set so that it feeds along the centerline of the mounting plate. While you tighten the lock ring down on the split-ring wedges, swing the handle back and forth until the drag is stiff and smooth.

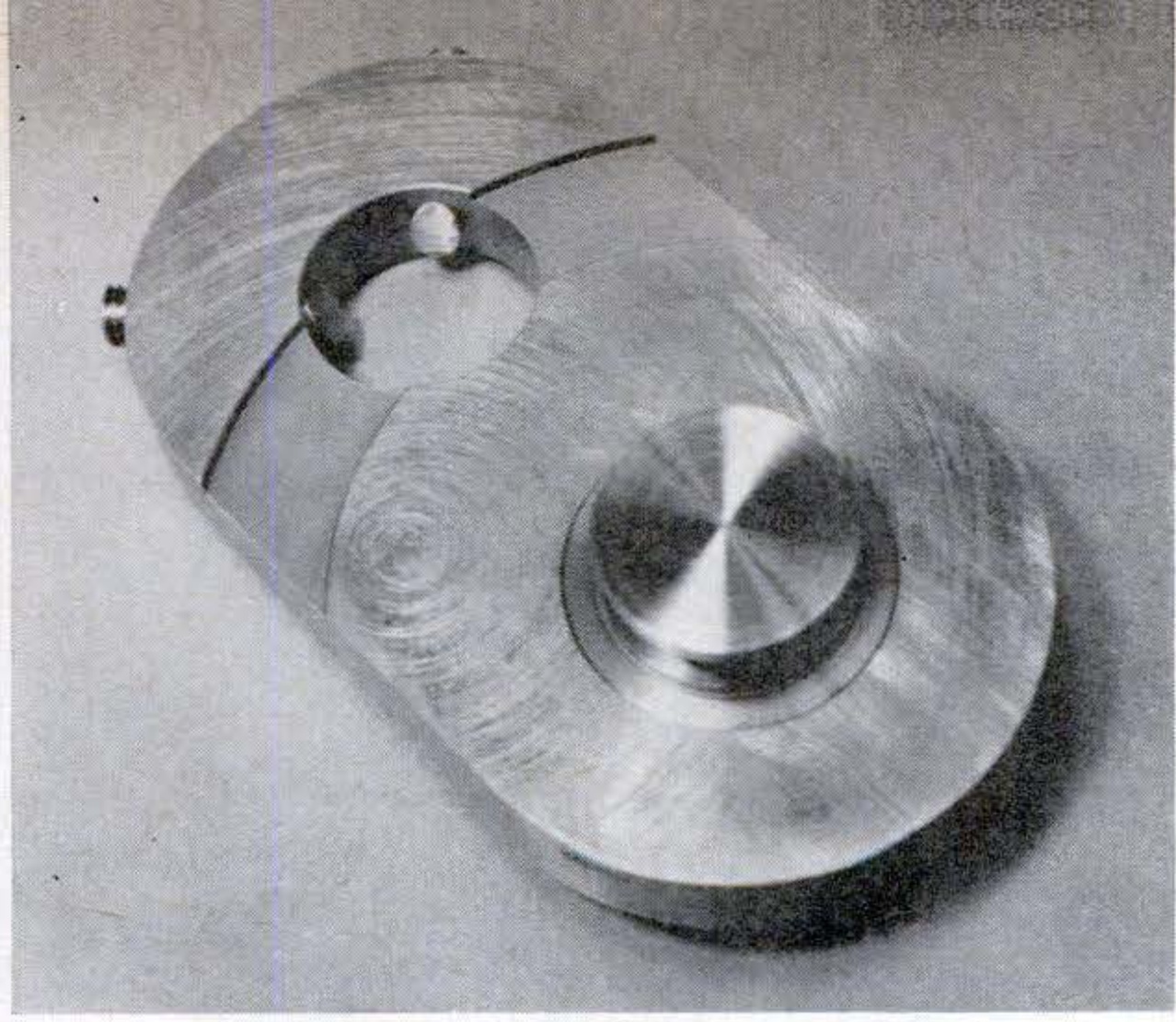


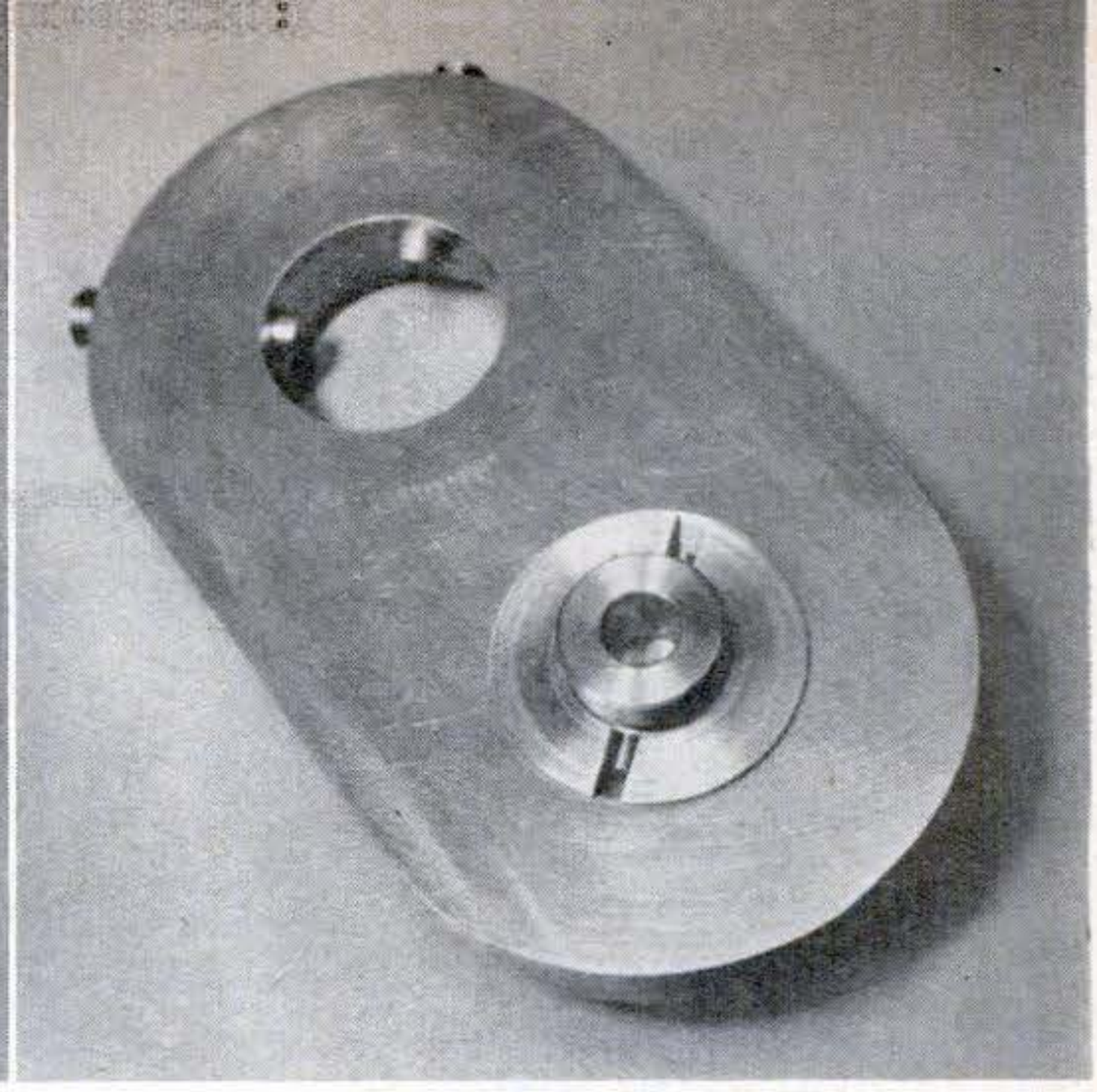
WITH THE APPROXIMATOR IN PLACE, wind in the cross slide until the approximator point and the tailstock center just touch at their tips. This places the pivot center approximately beneath the spindle axis. Now lock the toolholder so the bit just touches the tip of the approximator.

LOCK THE CROSS SLIDE by tightening the gibs after the pivot center has been located accurately beneath the spindle axis. *Don't touch the cross-slide crank from here on.* Next, locate the pivot point longitudinally under the center of the ball-to-be. Advance the tool with the compound feed until it just touches the turning work (left). Move the carriage to the right until the tool clears, then swing the attachment 90 degrees. Return the carriage until the tool touches the face of the workpiece. Lock the carriage to the bed and back off the compound.



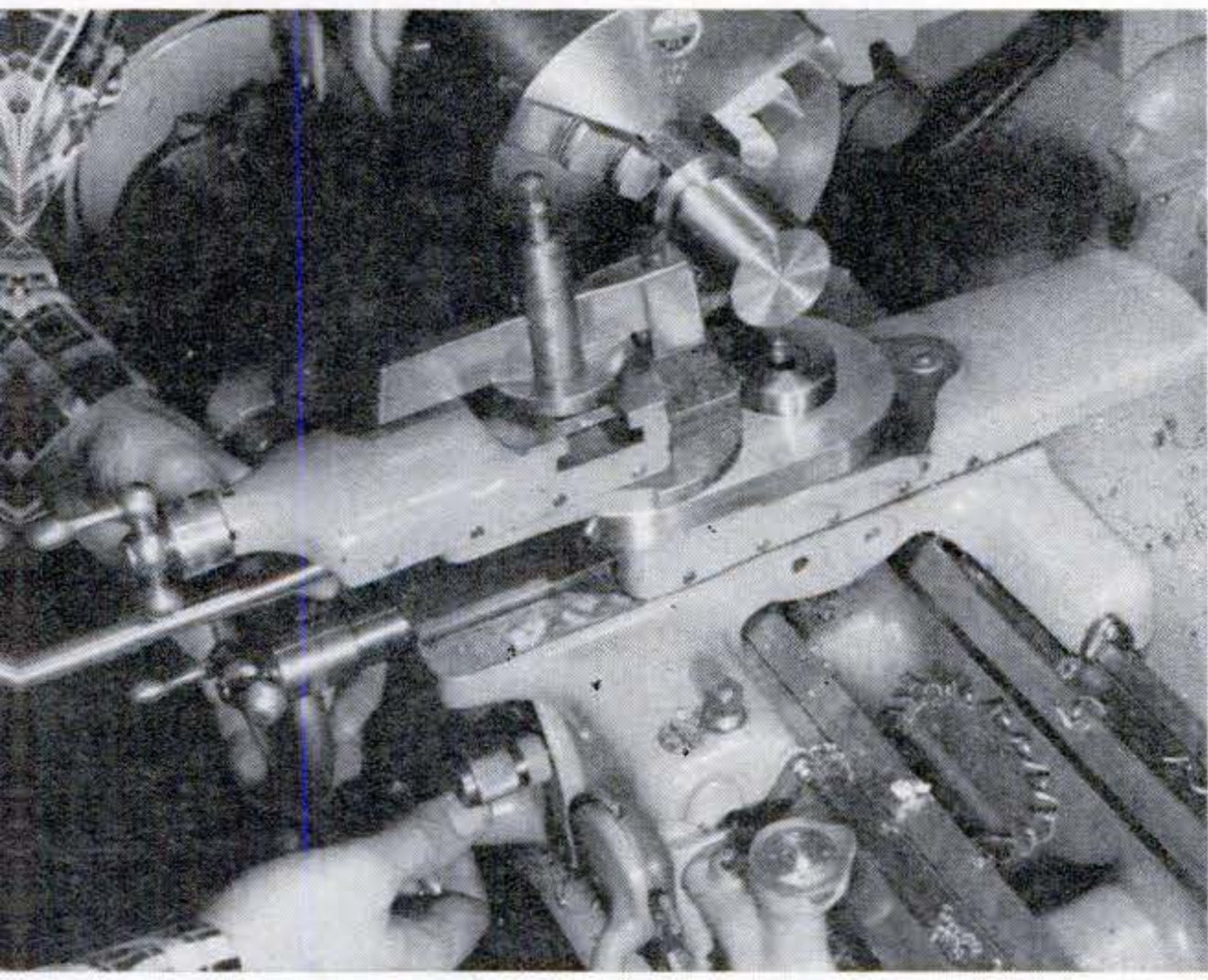


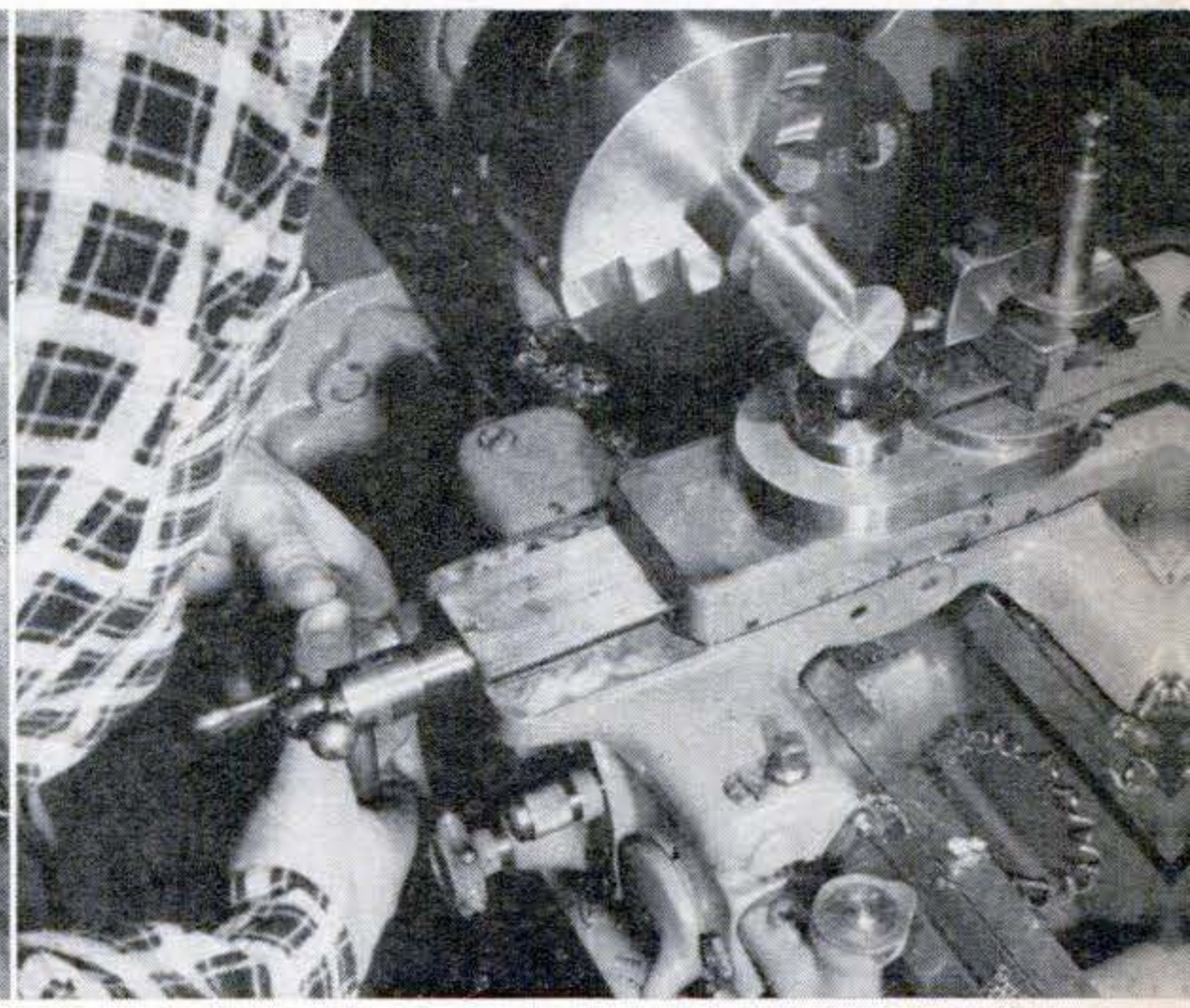




the bottom view of the mounting plate is to clear a boss on the cross slide. Top view shows key pins in place to keep the split-ring wedges from turning with the mounting plate.

for turning perfect spheres on a lathe

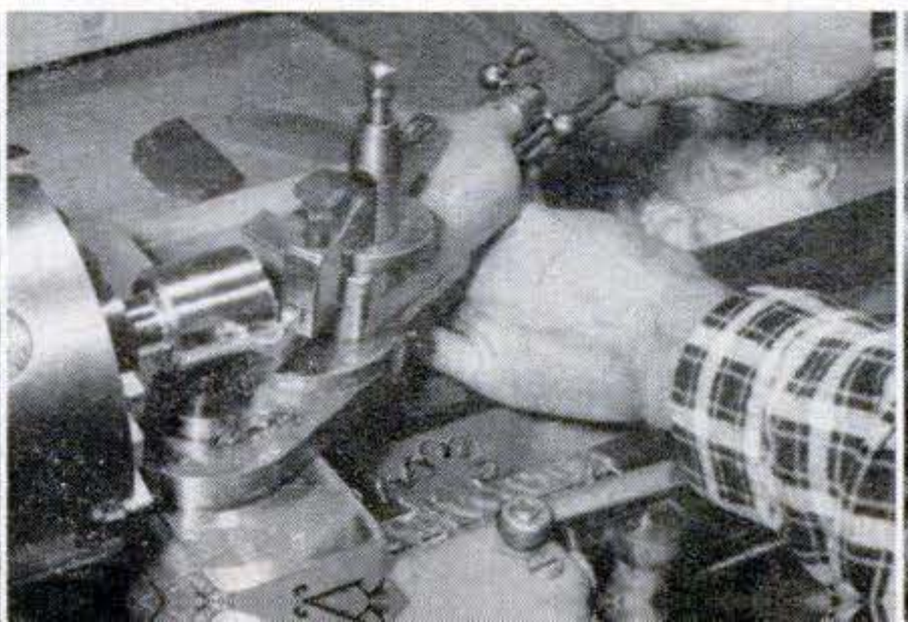


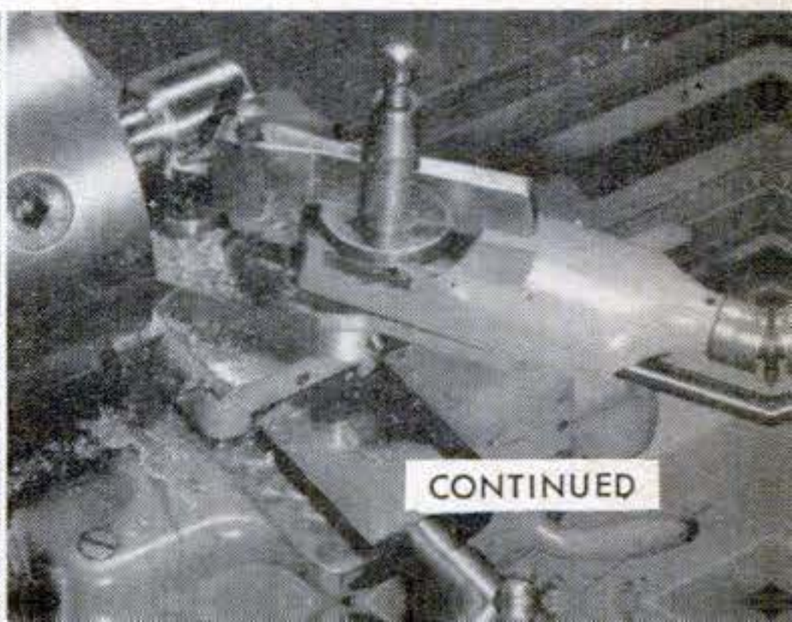


CHECK CROSS-SLIDE ADJUSTMENT to place the pivot center precisely under the spindle axis. Take a light cut at the outer end of the workpiece. Move the carriage to right to clear the tool and swing the attachment 180 degrees so the handle is pointing directly away from you. Run the lathe backwards and move the carriage to the left. If the tool cuts, the pivot center is too close to you; if it doesn't touch, it's too far. Readjust *cross slide* until tool just touches each side of the workpiece when the ball-turning attachment is swung 180 degrees.

How to turn a true ball with a minimum of waste motion

NOW, NO MATTER HOW YOU READJUST the toolholder or compound feed, you will be turning a true ball. Start each pass with the handle pointing away from you. Set the tool to take a reasonable cut off the outside corner of the workpiece. Successive cuts are made by pulling the handle at a slow even rate through its arc of travel. Feed in with the compound before each pass. Watch the progress of the tool to anticipate interferences. Readjust the toolholder as needed to get better angles of attack and to provide the necessary clearance.





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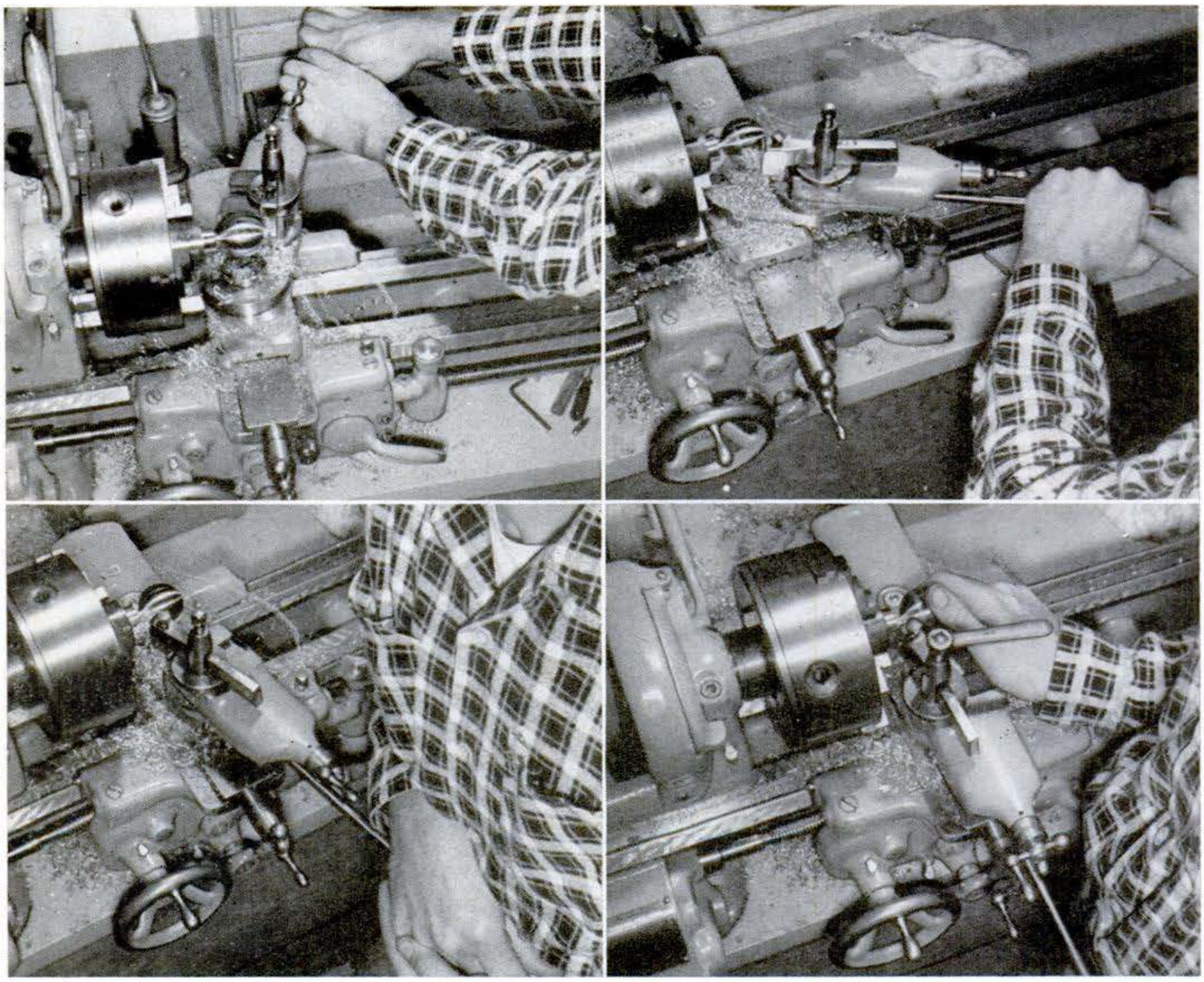
How to make the finishing pass and part-off



MAKE THE FINISHING CUT in one continuous smooth sweep. Carry the handle around far enough to part off the ball. Neck down the spud before the last pass to provide tool clearance.

attaching the compound are shown in the blueprint. It is wise to check the actual measurements of your own lathe for minor variations of parts where exact fits are involved. Also check for any obstructions that might interfere with the full 180-degree swing of the attachment.

Make the oval mounting plate first. The one shown here was made of ¾" hot-rolled steel plate, faced on both sides in the lathe to ⅝". If you can get ⅝" surface-ground flat stock, you will save yourself some work.

Rough out the shape somewhat oversize, leaving the edges rough until all the facing and boring is finished to avoid marring the edges in the four-jaw chuck. The arc channel cut in the bottom of the mounting plate for the South Bend attachment is to clear the boss of the cross-slide feed nut.

Next make the split-ring wedges. Mill or saw the .135" kerf shown between the ring-wedge ends before the bar stock is chucked in the lathe. Then, when you part off after the turning and boring operations, the two halves will fall apart, finished at once. In turning the 45-degree face, test its fit frequently in the mating conical hole in the mounting plate. Use bluing to assure that the faces bear their full width.

Now make the pivot post and two key pins. Be sure the ⅛" holes for the key pins are drilled true across the diameter of the post. If the attachment is for a South Bend, before assembling the post to the mounting plate, put the key pins in their holes and push them in all the way. After assembly, you can push the key pins out into position by using a small screwdriver to probe into the hole in the top of the pivot post.

[Continued on page 242]

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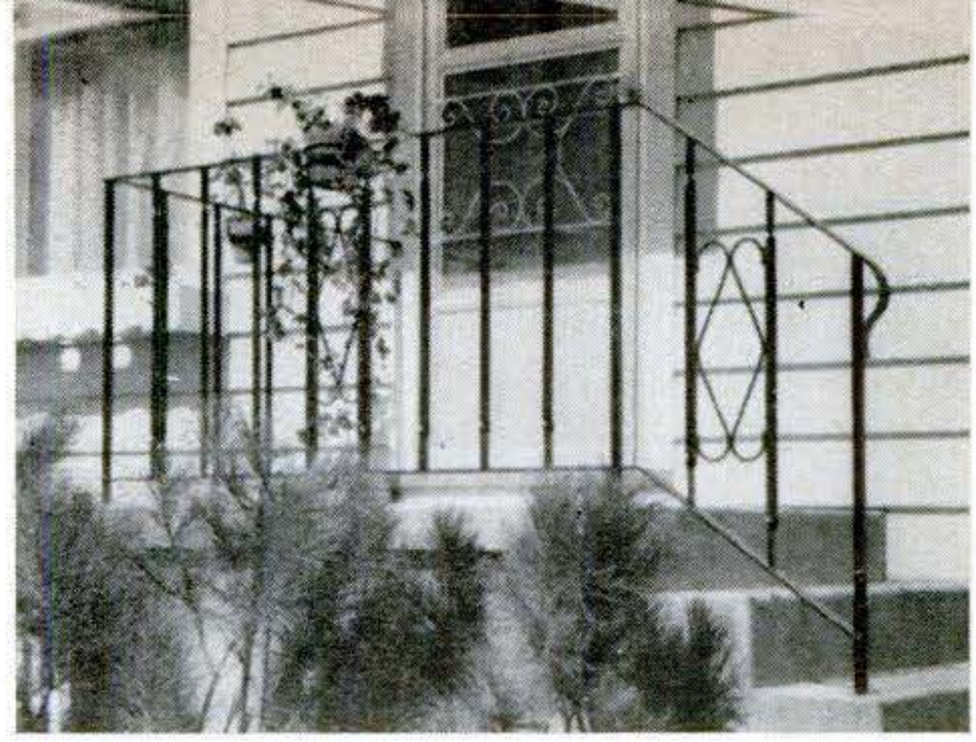
How to make a

Low-Cost Wrought-Iron Railing

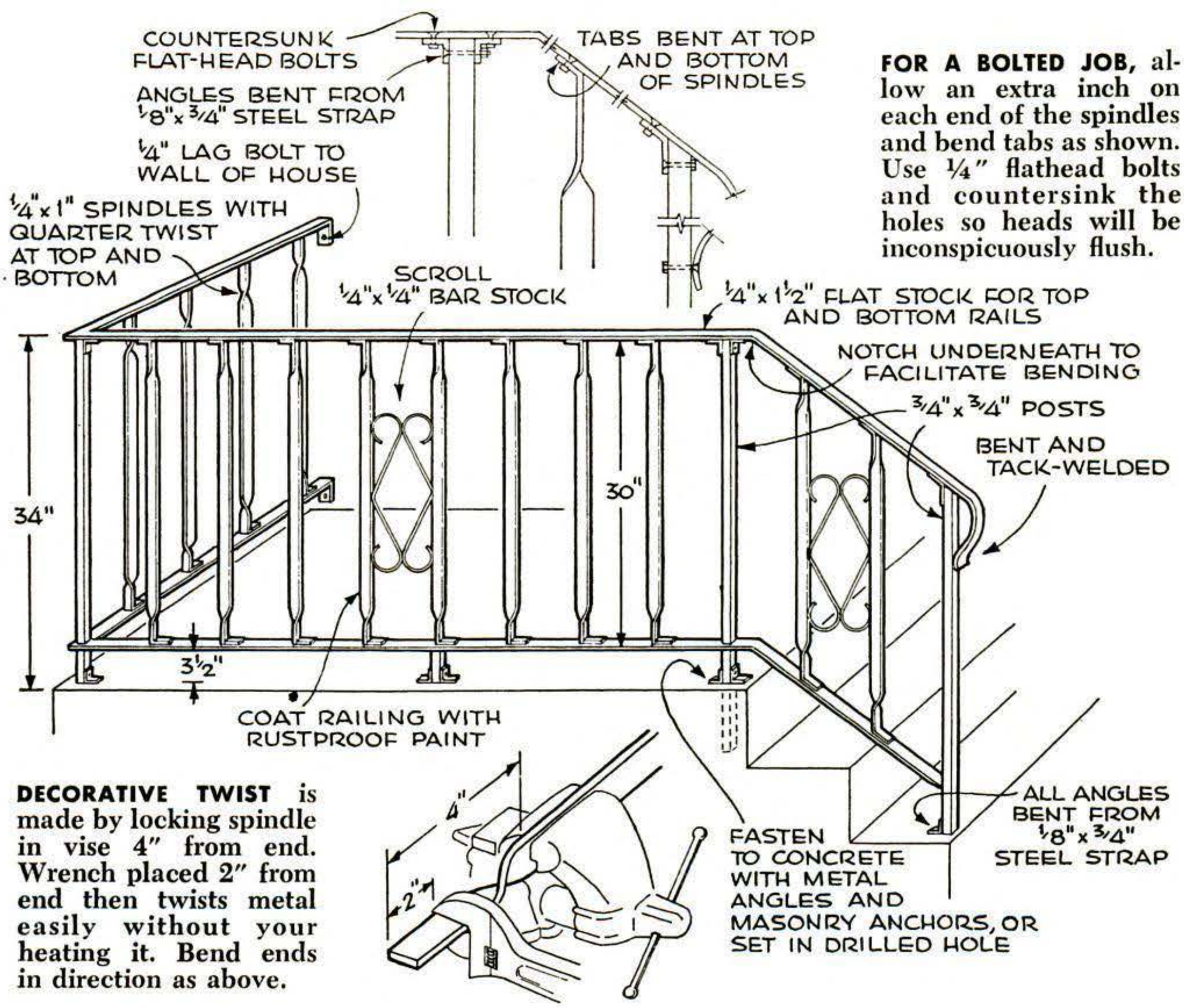


MAKING your own ornamental railing combines the fun of being your own blacksmith with a real benefit—you get the handsome effect of wrought iron at a fraction of the cost of custom-made railings. The one you see above is more than 10′ long, yet cost about $10.

All the parts are standard sizes of steel strap and bar stock. You save most by buying long lengths at a metal-supply shop. Short lengths are available at most hardware stores.

The secret of turning plain stock into a wrought-iron effect lies in giving each of the uprights or spindles a fancy quarter twist. This is done by placing each one in a vise and bending the ends with a wrench. The main supporting posts are lengths of ¾″-square bar stock, and the top and bottom rails are ¼″-by-1½″ flat stock.

Welding or brazing the parts gives the trimmest appearance, but they can also be bolted. By bending small angle-iron braces as shown, all of the joints can be made with nearly invisible flathead bolts. If you prefer a plainer design, the scroll can be eliminated, or additional scrolls can be more closely spaced for an even fancier appearance.—*Edwin Johnson.*



FOR A BOLTED JOB, allow an extra inch on each end of the spindles and bend tabs as shown. Use ¼″ flathead bolts and countersink the holes so heads will be inconspicuously flush.

DECORATIVE TWIST is made by locking spindle in vise 4″ from end. Wrench placed 2″ from end then twists metal easily without your heating it. Bend ends in direction as above.

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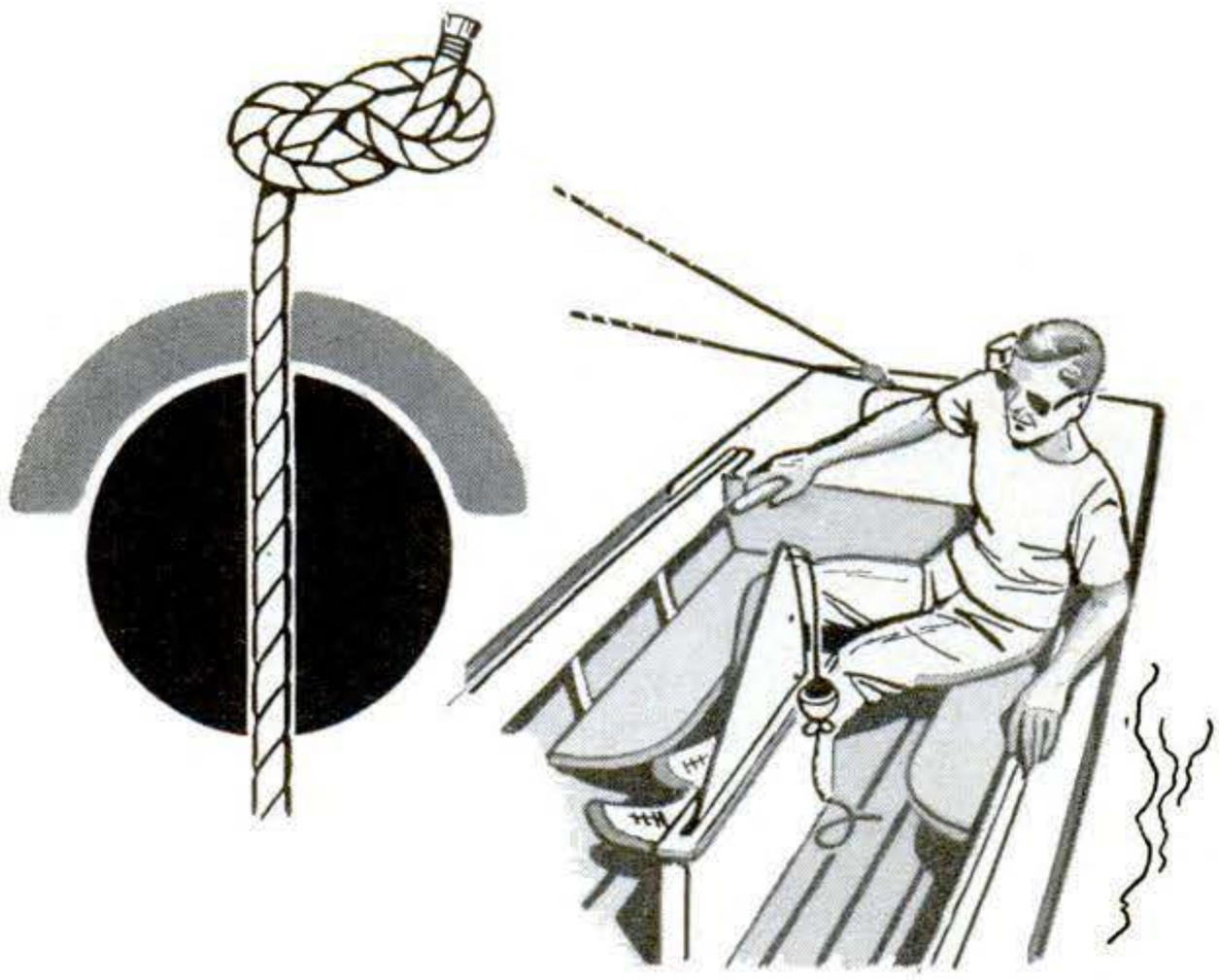
For the Boat Owner

How to Glide a Boat on a Hubcap

ONE man can easily launch or beach a small boat or canoe by means of this simple trick: Slide one end on a discarded automobile hubcap. Drill the edge of the cap for a cable to fasten the cap to the boat.—*G. E. Hendrickson, Argyle, Wis.*



Better Centerboard Stop

IN A small sailboat, a plywood disk or button is usually used to snub the centerboard supporting rope against the slot in the top of the centerboard case. It's better to use a sponge-rubber ball, for it won't mar the top of the case. Slip an awl through the ball, follow it with a piece of sharpened copper tubing, push the rope through the tubing, and pull out the tubing. A bowl-shaped turning of hardwood over the ball will help keep the ball in shape.

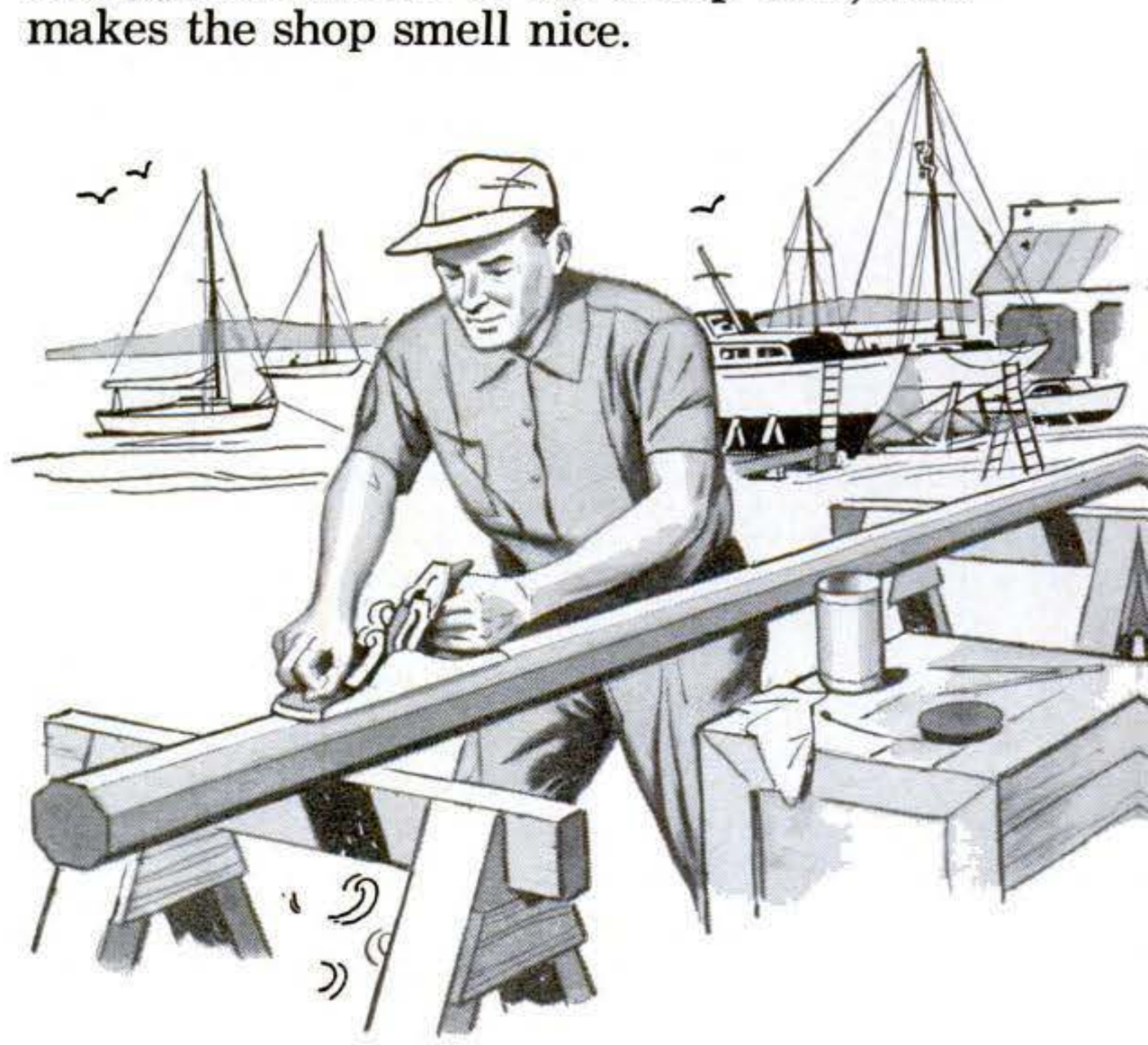
Talcum Powder Eases Planing of Round Masts

TO MAKE a round mast, say the books on boatbuilding, you must first make your stick four-sided, or square in cross section, with the proper taper. Then, using proportional dividers, a tightwire line, and a straightedge, you're told to mark off the spar for trimming to octagonal cross section. Do this once more and you have a 16-sided spar.

Difficulty comes when you try to trim down that 16-sided shape—first to 32 sides, then 64, before using the coarse sandpaper for final rounding. It is nearly impossible to see exactly where your plane has been as you work down the increasingly obtuse angles.

The answer? Buy some cheap white bath talcum at the dime store and wipe it liberally over the surface of the 16-sided spar. Now each stroke of the plane will bare naked new wood that contrasts sharply with the powdered wood.

Your only task is to keep the stripe of new wood exactly the width of the stripes of powdered wood on each side, as you plane your way around the mast. Further, talcum powder makes the plane slip along easily, is harmless to the sharp iron, and makes the shop smell nice.



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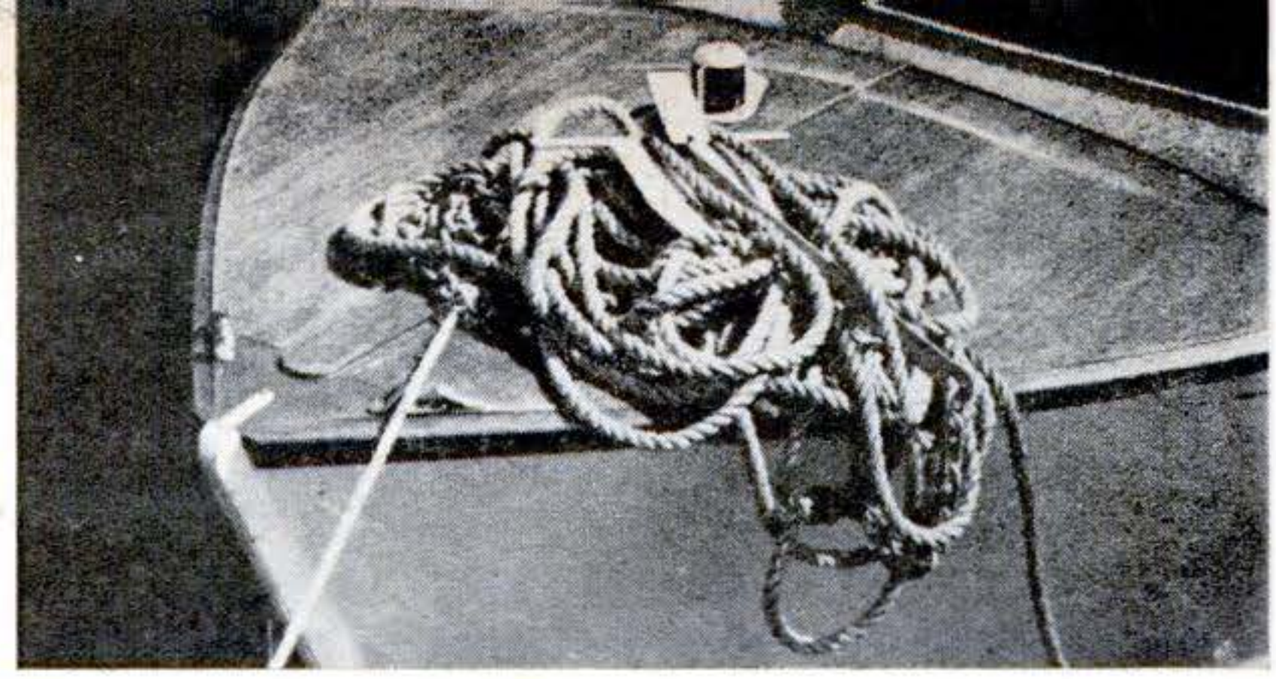
Can You Moor a Boat?

Sure—but test yourself on these 12 questions and confirm how good your seamanship is

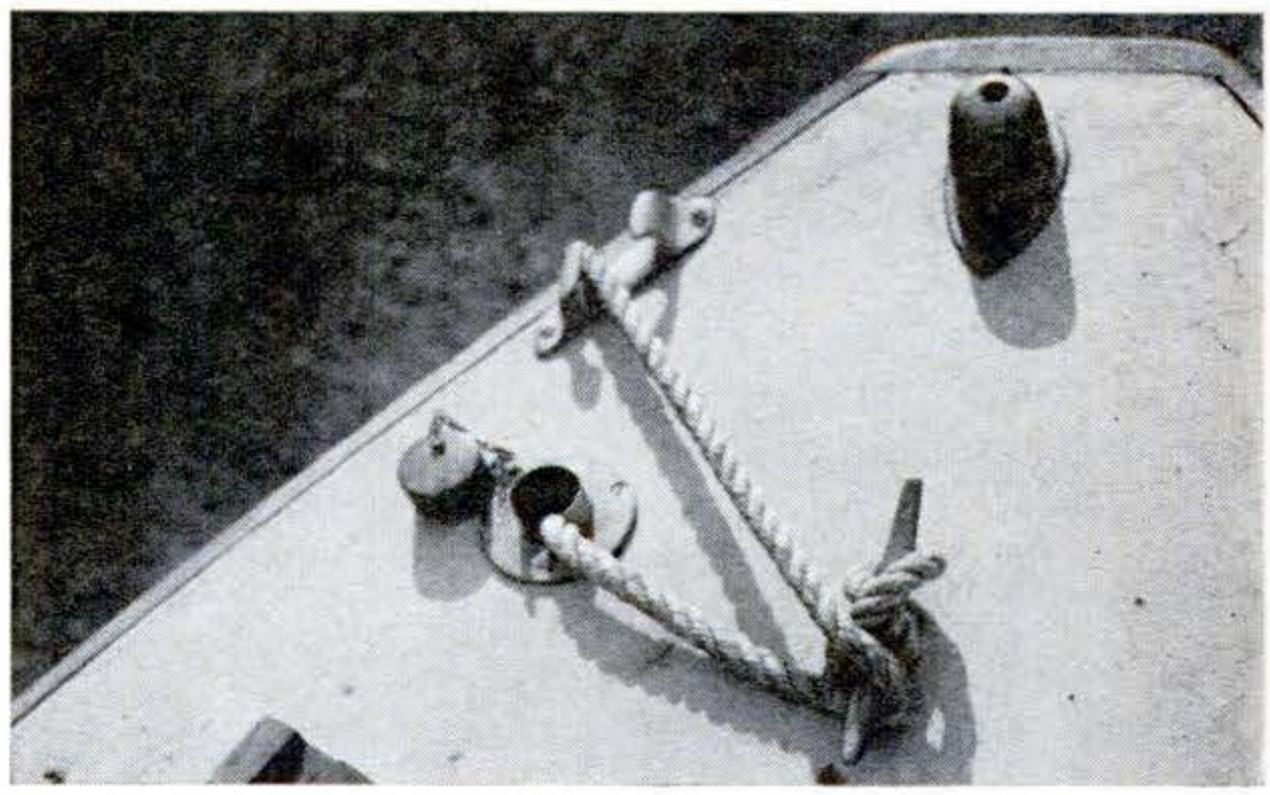
ANY kid who has ever paddled a raft knows you just tie a rope to your craft and fasten it to something solid ashore. Still, thousands of supposedly well moored or anchored boats go adrift every year, and some are lost.

Considering the value of a boat, good mooring techniques are money-in-the-pocket protection against serious loss or damage. On this and the next two pages you can test your nautical know-how on this important bit of seamanship.—*F. C. Clark Jr.*



Poor seamanship

TANGLED MASS OF ANCHOR AND ROPE spells sure trouble for this skipper when he needs to get a line over fast. Come a big wave, the precariously perched anchor will go overboard—and may take something or someone with it.



Good seamanship

BOW IS KEPT NEATLY CLEAR with this through-the-deck arrangement for stowing anchor rope. Pipe with removable cap prevents fouling of the line and keeps it dry and ready for use, yet safely out of the way.

1 A sturdy cleat, bolted to the deck, is not the safest way to moor a boat. ☐ TRUE ☐ FALSE

2 Practically any good size rope is safe enough for mooring small craft. ☐ TRUE ☐ FALSE

3 You can eliminate rope chafing by installing a set of smooth chocks. ☐ TRUE ☐ FALSE

4 A well-made seagoing knot will severely weaken any rope, even a strong one. ☐ TRUE ☐ FALSE

5 Rope splices, while neat, are usually considered unnecessary on small boats. ☐ TRUE ☐ FALSE

6 Mooring lines should have a breaking strength of double the weight of the boat. ☐ TRUE ☐ FALSE

7 You shouldn't trust the big mooring rings and cleats found on wharfs. ☐ TRUE ☐ FALSE

8 On small craft, the bow deck is the best place to stow anchor and line. ☐ TRUE ☐ FALSE

9 Chain is rarely necessary in anchor lines for small boats and light anchors. ☐ TRUE ☐ FALSE

10 An anchor's weight is the main thing that determines its holding power. ☐ TRUE ☐ FALSE

11 Scope is the distance between your boat and the one anchored next to it. ☐ TRUE ☐ FALSE

12 Anchors of modern design will not foul their own line when in the water. ☐ TRUE ☐ FALSE

Now check your answers on the next two pages

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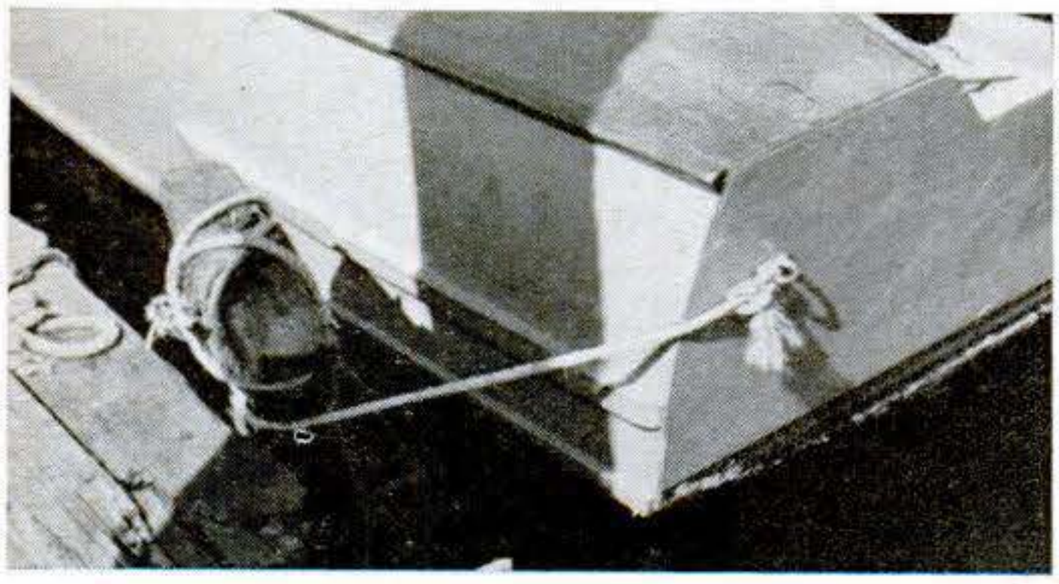
1 TRUE. While deck cleats are handy, an eye bolt through the stem or transom is stronger and safer. The trouble is usually not with the cleat itself, but with the deck. In storm surges, both cleat and deck are frequently torn clear off. If you do use cleats, fix them so they could support the full weight of the boat by bolting metal plates to them under the deck, and running rods or strap iron to the keel or transom.

2 FALSE. Size alone doesn't mean strength. A big rope can be weak if the innards are rotted. And there's a lot of difference in types of rope. One kind can be good for some uses around a boat without being the best for mooring. For anchoring and mooring, three materials are tops: Manila, nylon, and polyethylene. Manila, the traditional favorite, is relatively inexpensive, easy to splice and has fair elasticity, which is desirable in a mooring line. It can rot, though, if stored wet, so be sure to dry it first. Nylon is more expensive than Manila, but should last longer. Being a synthetic, it won't rot or mildew. Unlike Manila, it should be stowed wet, as sun can harm it. It has a lot of elasticity and is somewhat harder to splice than Manila. Polyethylene, another synthetic, is easy to splice, inexpensive, and won't rot. It is not, however, as nice to handle as nylon or Manila, has little stretch, and is often used with an elastic snubber in the line. Cotton, dacron, and linen ropes are all useful around a boat, but are not as suitable as any of the other materials for mooring lines.

Poor seamanship

SAFE? Owner of this "cat" thinks he is, with a good solid square knot in his bowline. But ropemakers calculate that a square knot can reduce a line's strength by more than 50 percent.



RICKETY PIER CLEATS should not be depended on, no matter how big they look. This skipper has the right idea, though, with sturdy eye bolts in transom instead of relying on weaker deck.

3 FALSE. Chocks are important, but your line can chafe on other spots, especially if it jumps the chock. A section of garden hose slipped over the rope at rub points is a good way to prevent chafing and keep your line strong.

4 TRUE. The sharp bends caused by a knot weaken the outside fibers of a rope, resulting in a considerable loss of strength. An overhand or square knot reduces strength up to 55 percent, a clove hitch and bowline up to 40 percent. Winding the line around a cleat will similarly weaken it by causing sharp bends in the fiber.

5 FALSE. An eye splice over a metal thimble takes only five to 10 percent of the strength out of a line. Even without a thimble you still lose only 13 to 15 percent. Compare these figures with the weakening effect of knots (above) and you can see why splices are as important on small boats as on large ones.

6 FALSE. Rigging experts say that a line should not be loaded to more than 20 percent of its breaking strength. This means that a line must have a breaking strength of, not double, but five or more times the weight of your boat. Your marine dealer has tables that will tell the breaking strengths of various sizes and types of line.

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7 **TRUE.** It isn't the size of a ring or cleat that determines its strength. Many big ones on old piers are attached to rotted planks or rusted bolts that may give way in a storm. Always check the soundness of a cleat before trusting it with your valuable investment.

8 **FALSE.** The bow deck may seem mighty convenient for an anchor, but it's too small and pitches too much on a small boat to be the safest place. The line will snarl into a rat's nest and that means trouble when you have to use an anchor in a hurry. The best place to stow your anchor on a small boat is below decks, with the line neatly coiled out of the way. If you do carry an anchor on deck, make sure it's secure. If not, it may go overboard when you hit a good-size wave, and damage the deck or sides.

9 **FALSE.** Although you couldn't easily carry 100 feet of chain in a small boat, a short length (5′ to 10′) between line and anchor is good protection against wear. It keeps the line from rubbing on rocky bottoms and on the anchor itself. It also lies on the bottom and serves as a shock absorber for the initial strain on the line.

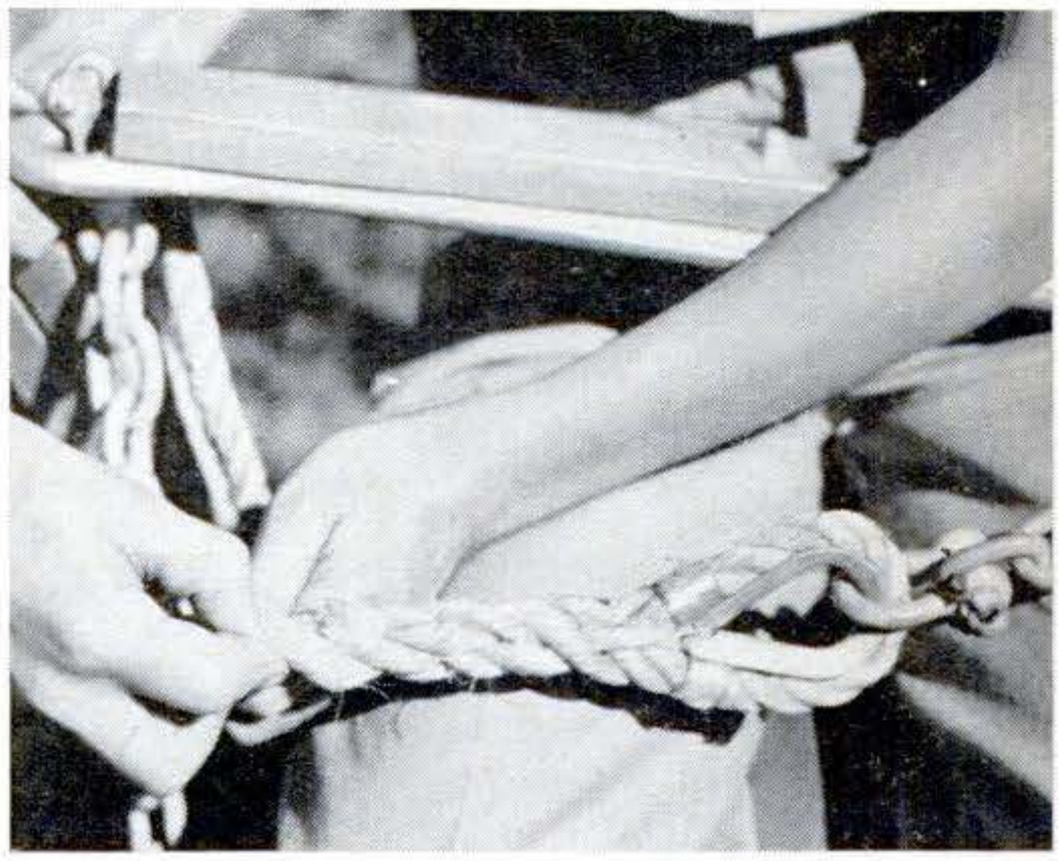
10 **FALSE.** Good design, not weight alone, determines an anchor's holding power. A well-made lightweight anchor that digs in properly will hold many times better than heavy old-fashioned anchors or plain large weights, such as old flywheels.

11 **FALSE.** Scope is the relationship between the length of your anchor line and the depth of the water. Let out 40 feet of line in five feet of water and you have a scope of eight to one. The longer the scope, up to about 10 to one, the better an anchor will hold. Where other boats close by won't permit you to use a long scope, you can often increase an anchor's holding power this way: Pay out line and set the anchor as if on a long scope, then shorten up until you're clear of surrounding craft. An anchor set on a long scope like this will dig in a lot deeper than one on a short scope.

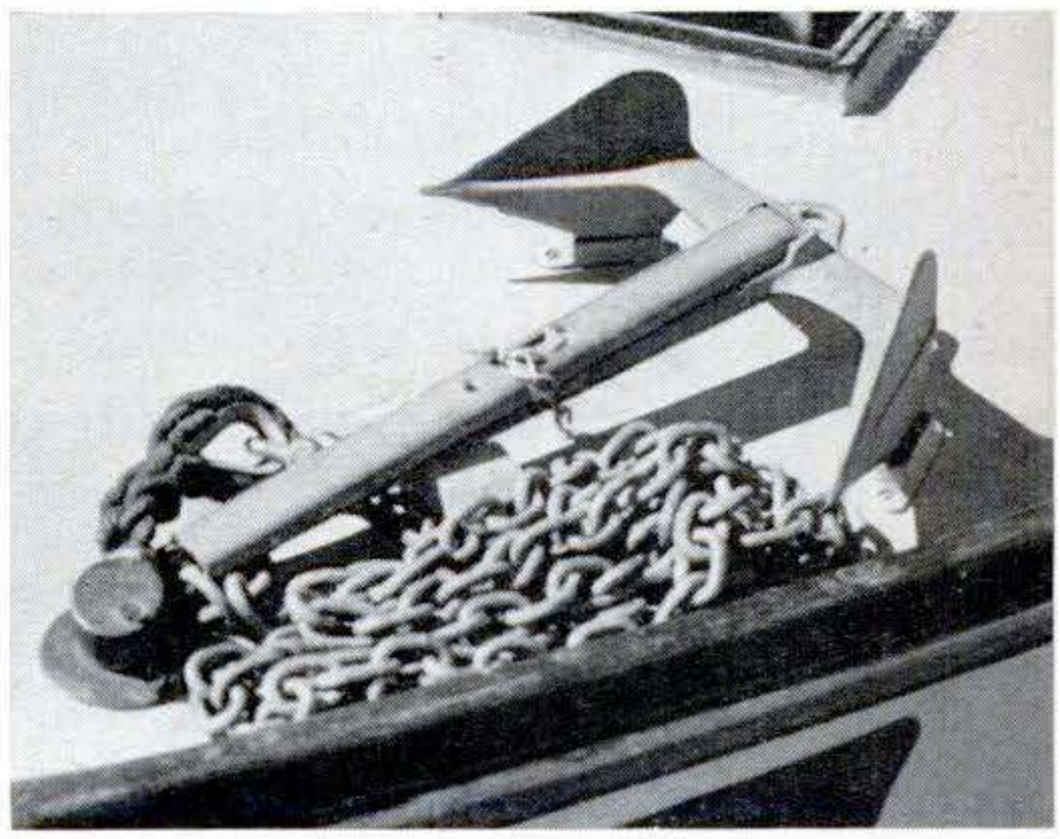
12 **FALSE.** The showoff who heaves anchor and line overboard in one mighty toss soon discovers that modern anchors can foul their lines as easily as old-fashioned ones if care is not taken. If you want your hook to act like one, lower it over the side gently and pay out the line gradually as you go to keep it off the anchor. The only place for a fouled anchor is on your yachting cap.

How did you do? A score of eight right is passing. Ten right and you're pretty sharp. Over 10, you're an expert.

Good seamanship



ROPE SPLICES, often considered unnecessarily frilly on small boats, are the only way to avoid great loss of strength caused by knots. Use metal thimbles to prevent chafing.



SECURE IN ANY WEATHER, this anchor is well chocked and tied down. A short length of chain protects the rope from rocky bottoms, yet saves carrying a full length of heavy chain.

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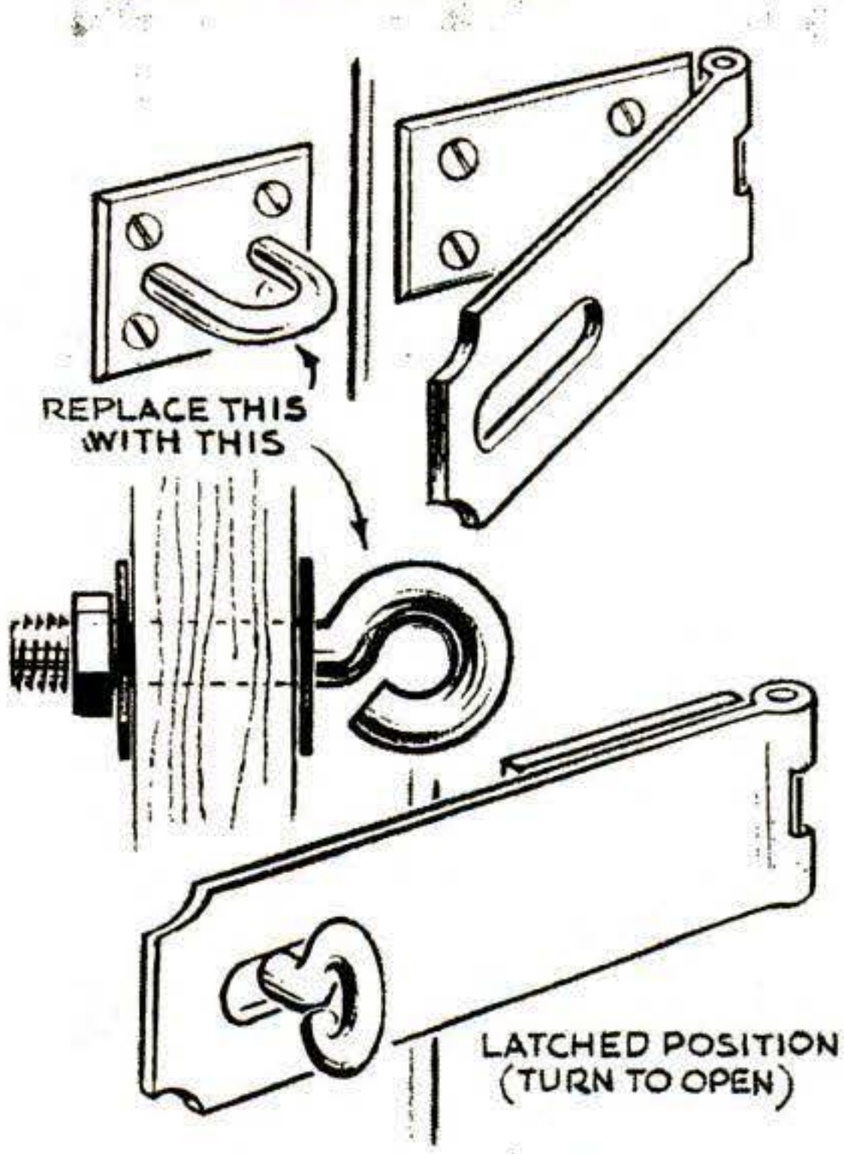
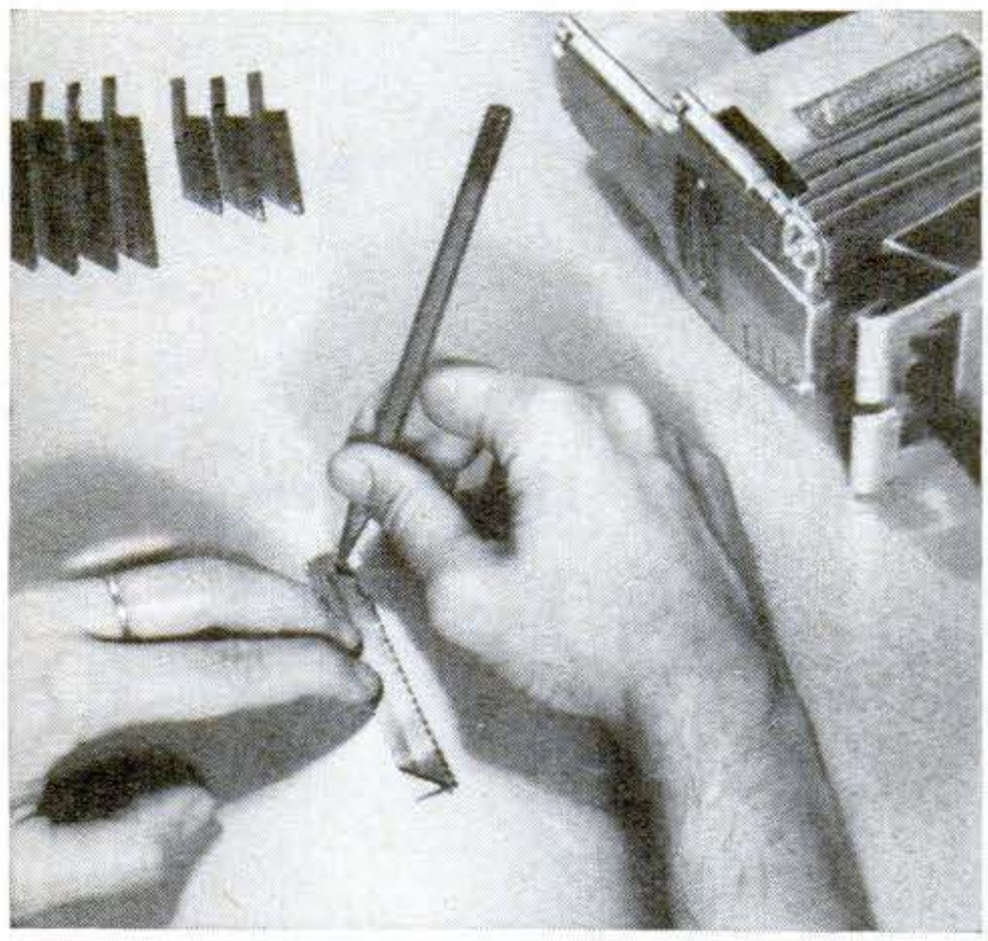


Eyebolt Used as Lock Hasp

REPLACE the staple plate of a lock hasp with an eyebolt as shown in the drawings above. Then you won't need a peg to keep the door closed. Install a washer under both the nut and the eye so that the bolt will turn freely. —*Norm Jacky, Seattle.*



Homemade Saber-Saw Blades

IF YOU break your last saber-saw blade, try making a few from a broken bandsaw blade. If available, use a ½"-wide blade, which has more backbone. Cut or break it to the right length, scribe the outline of a saber-saw blade, and grind to proper shape. You'll find that you have a good substitute.—*Robert Micals, Freehold, N. J.*

A hair dryer warms the air, and filters clean it in this—

Low-Cost Film Dryer

A CABINET that provides speedy, dust-free drying of negatives is usually a photographic luxury. This one ingeniously combines an ordinary hair dryer with a couple of standard furnace filters to give clean, heated air. Even if you use a new hair dryer, you'll find that a comparable commercial film dryer may cost six times as much as this one.

Made of hardware-store aluminum, the dryer is light and compact enough to hang on a wall, freeing precious counter space. The frame is formed of 1"-by-1" aluminum angle $\frac{1}{16}$" thick, assembled with sheet-metal screws. One furnace filter fits into aluminum-angle rails 4" from the bottom of the cabinet. Air from the hair dryer is blown into the chamber below this filter and forced up through it past the film racks. A second furnace filter fits into an aluminum-angle recess at the top of the cabinet, permitting air to flow out without dust settling back in.

The cabinet shown is designed to take standard 10"-by-25" fiber-glass filters, but is made slightly longer than the filters to provide adequate rack space for 26 film clips. Gaps at the ends of the filters are filled in with spacer strips cut from aluminum sheet. You could also build the cabinet smaller to fit the filters exactly.

Details of design. The frame of the cabinet is covered with insulated panels made by cementing .020" embossed aluminum sheet to thin asbestos sheet. The edges of the aluminum are folded ½" around the asbestos, and the panels are fastened on with sheet-metal screws. Sliding doors are made in the same way as the side panels except that an addi-

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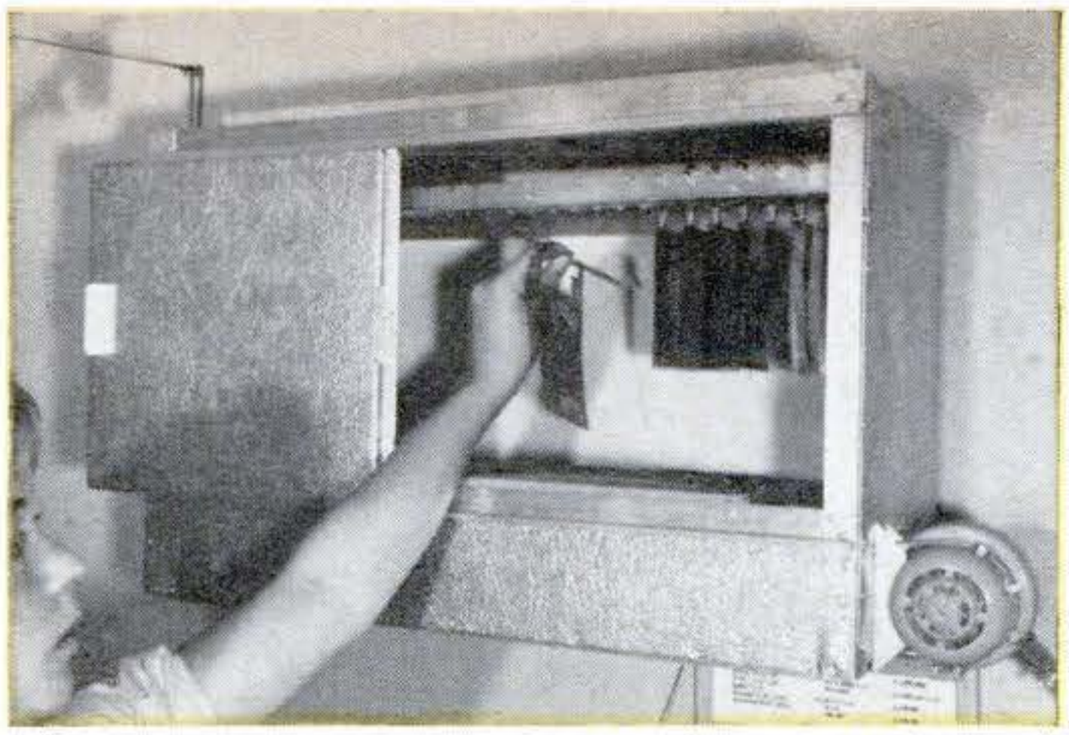
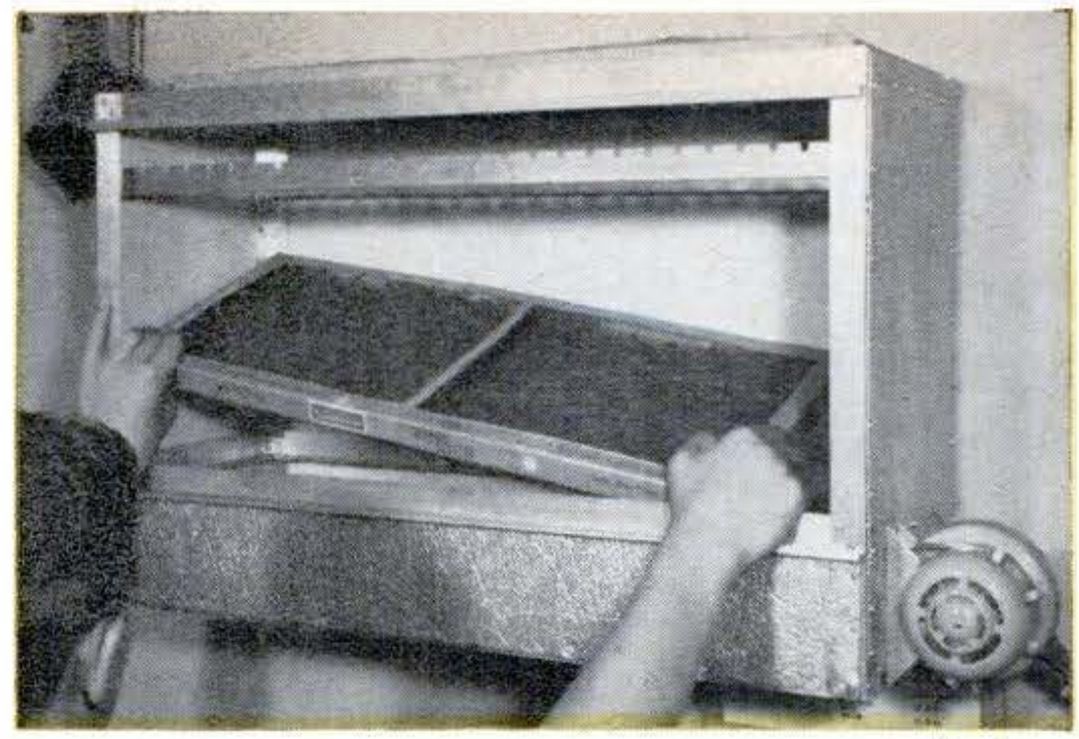
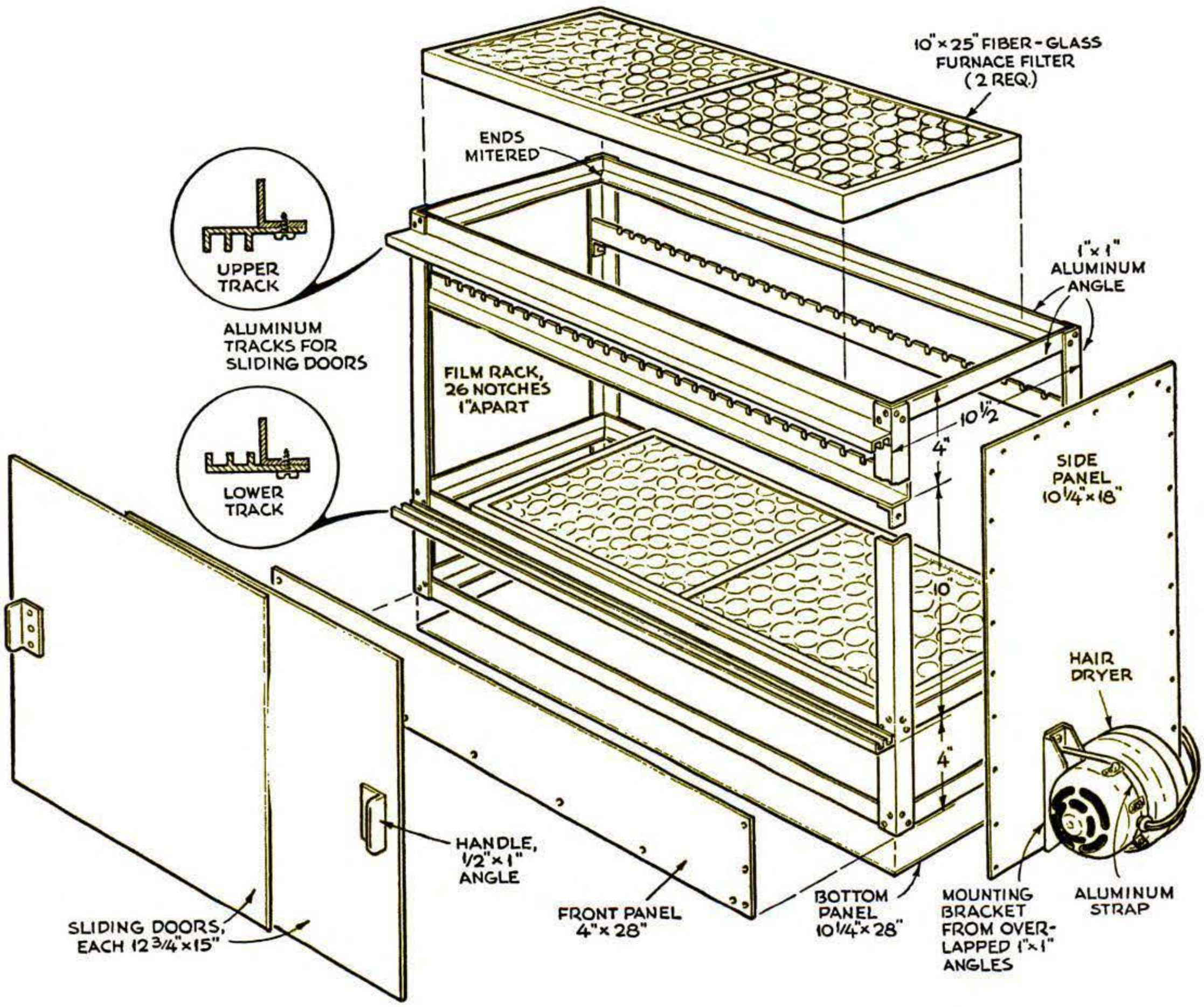


POWERED BY HAIR DRYER, film dryer holds up to 26 film clips in cabinet only 28" wide. Hair dryer, mounted in side of cabinet, blows hot air into filtered chamber at the bottom.



TWO ORDINARY FURNACE FILTERS, one below and one above the film, assure circulation of clean air from the hair dryer. Filters used are "Dust-Stop" type made by Owens-Corning.



tional sheet of plain aluminum is cemented to the inside face to keep the asbestos fibers from rubbing off and causing dust.

All sheet-metal screws for both the side panels and frame are No. 6 cadmium-plated ½" long. These require an outer hole of ⅛" for clearance and an inner hole of 7/64" to screw into.

The drying racks are notched at 1" intervals and are designed primarily for 4"-by-5" cut film, but will also handle 5"-by-7" cut film and roll film cut into segments. The latter should be weighted with a bottom clip to prevent curling.

After developing, the film should be treated with a wetting agent and allowed to drain a few minutes before racking. Drying will take 15 to 20 minutes.—*W. Herdman Schwatka Jr., Towson, Md.*

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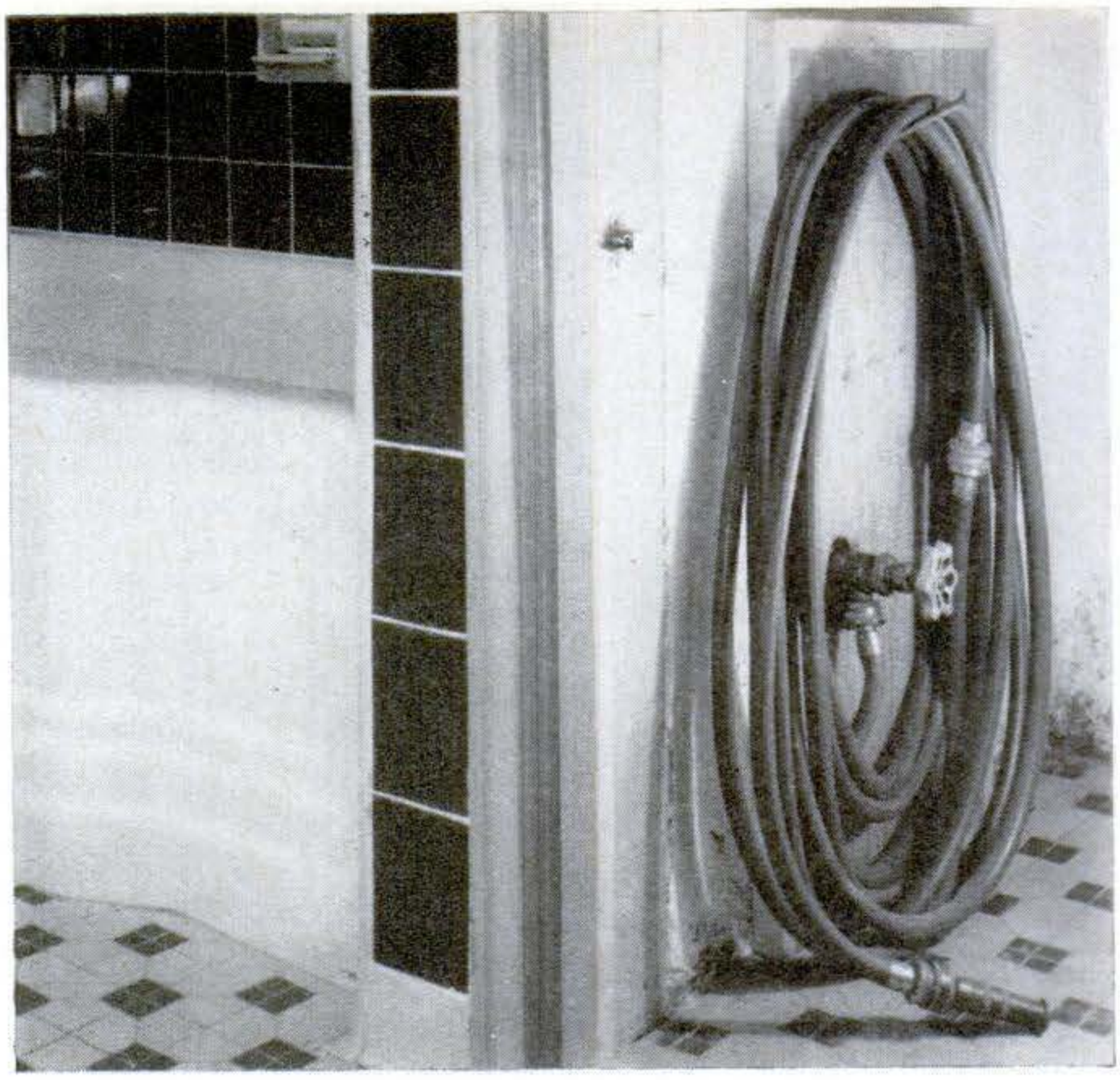
Short Cuts and Tips

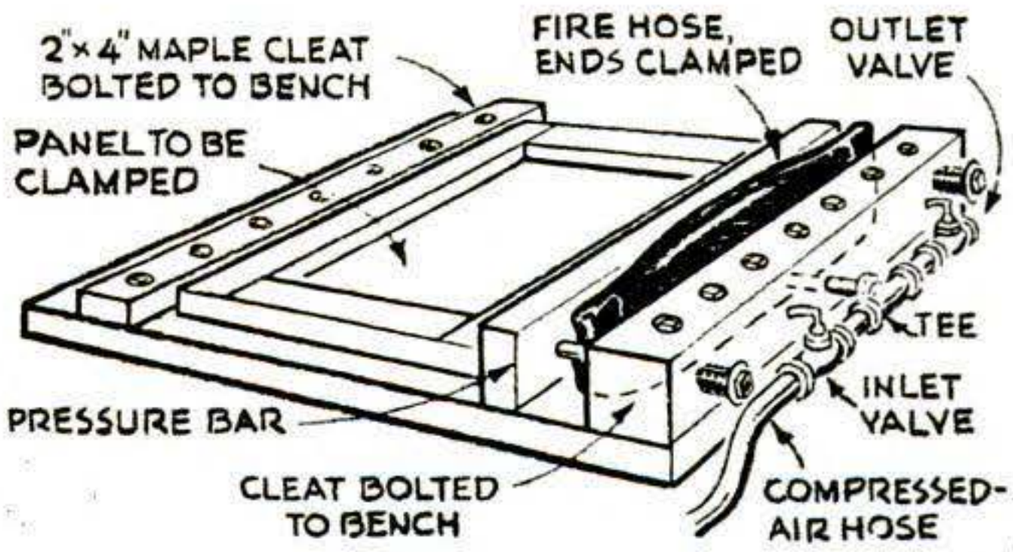
FROM PS READERS

Fire Protection for Second Floor

SINCE I live about four miles from the volunteer firehouse, I keep "at-the-ready" a plastic hose long enough to reach any area on the second floor. It's attached to a spigot that taps the cold-water pipe in the plumbing-access area behind my upstairs bathtub. I also keep another hose ready downstairs.—*K. J. Krausse, Rockville, Md.*



▶▶▶IF YOU find yourself short of batteries to operate a multicell flashlight, make fill-in dummies from short lengths of broom handle covered with aluminum foil. Shove them in behind the live battery units. The foil will make contact.—*John Mihalick, East Liverpool, Ohio.*

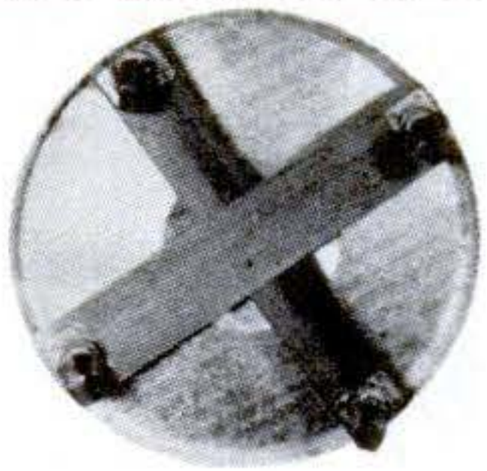


Quick-Acting Panel Clamp

THIS pneumatic clamp was rigged for production use in a small furniture plant. Air pressure expands a length of fire hose to exert side pressure on the panel. One valve lets compressed air through ½" pipe welded to a tire valve clamped in the hose. The other valve relieves the pressure to deflate the hose. Springs pull the pressure bar against the flattened hose to open the clamp. The clamp's capacity is changed by moving the rear cleat. The clamp can be made any length. —*E. R. Hickman, Grand Rapids, Mich.*

Trash Can on Wheels

PUT a garbage can on wheels and you have a handy trash collector for your workshop. Roll it around to pick up loads, then push it back under the bench. The wheels are plastic casters mounted on a cross frame of two-by-fours made with a half-lap joint. It is held friction-tight by the flange at the bottom of the garbage can.—*Jerry Parker, Sonoma, Cal.*



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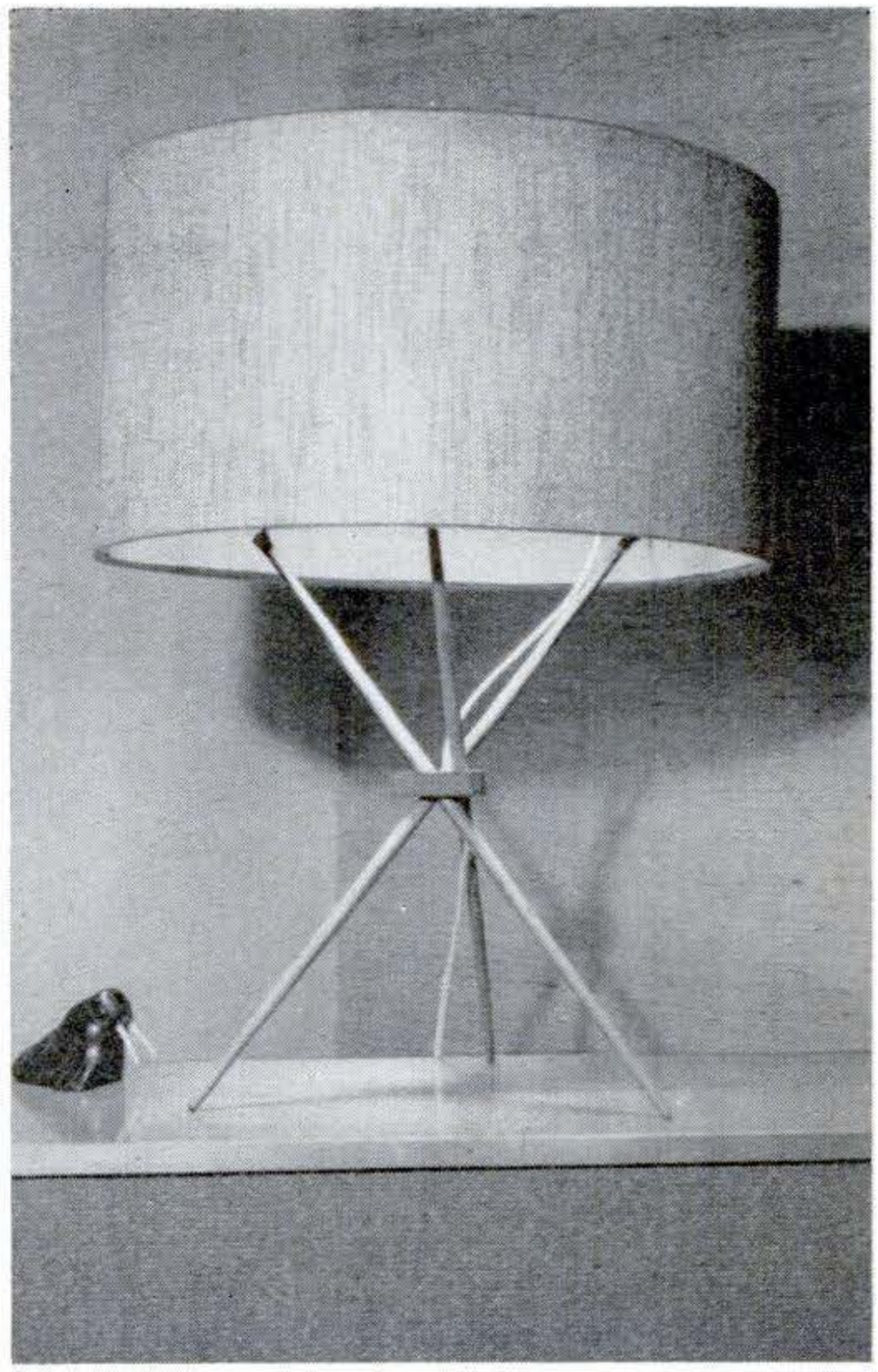
From homemade teak dowels and brass welding rod:

A Tripod Lamp

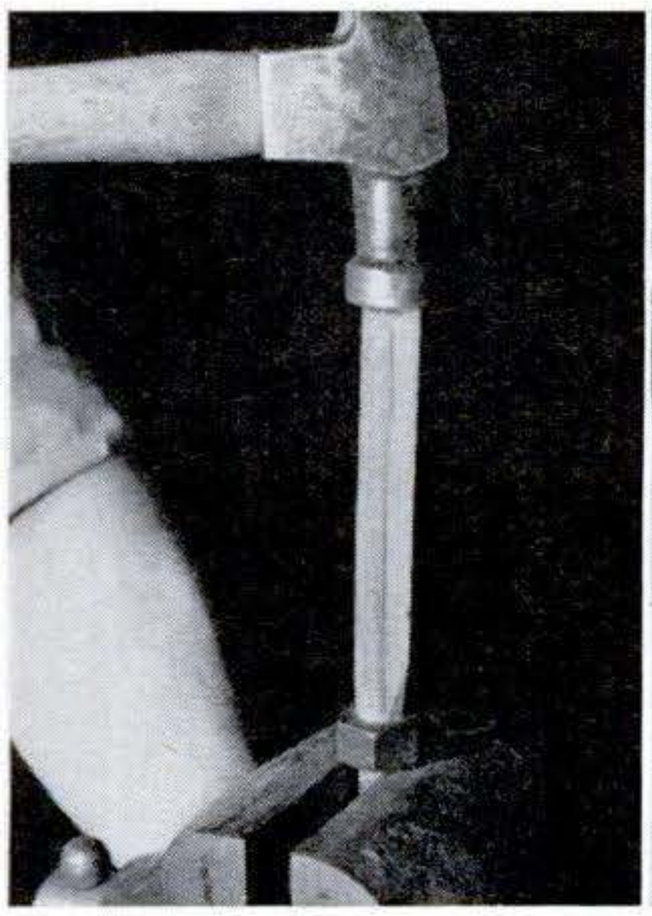
By Clifford A. Fenner



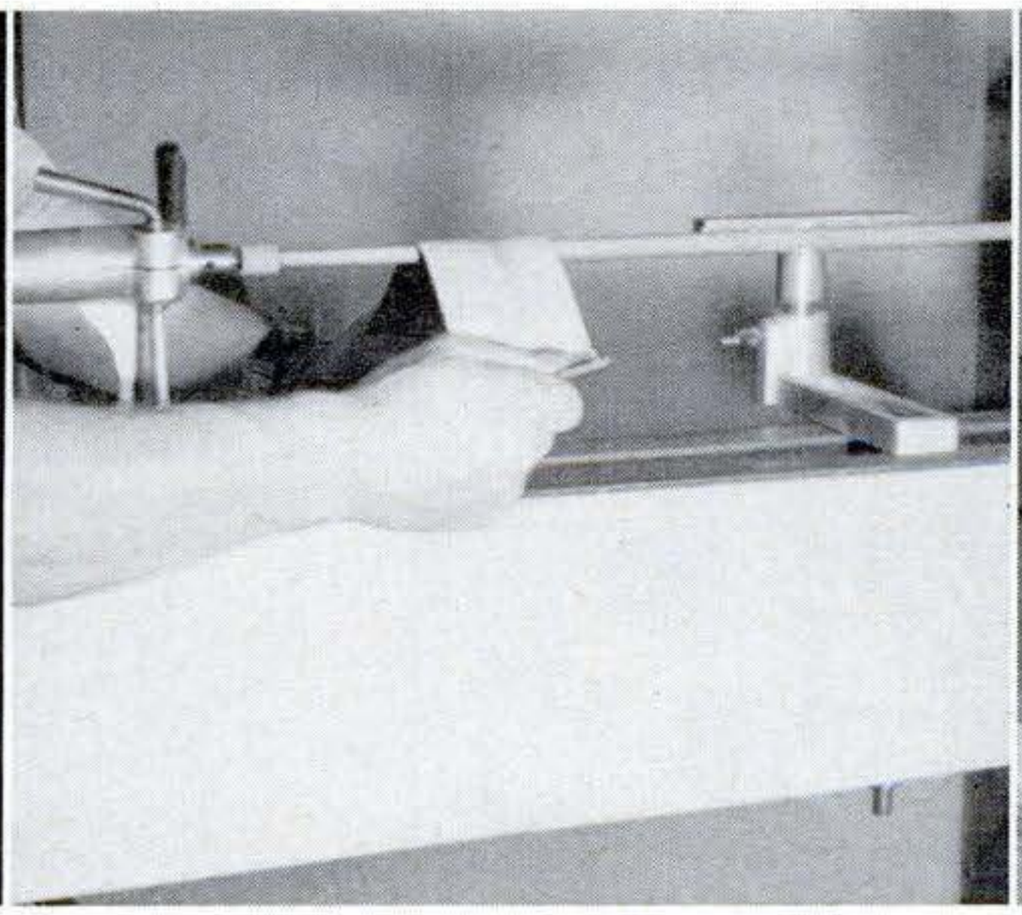
FINDING a lamp that looks as if it belongs in a room you've already decorated can be a problem. The color's an indifferent match, the proportions seem all wrong. Often the surest solution (though not the easiest) is to make your own lamp.

This smart tripod lamp is a good example. The spindles are made of scrap pieces left over from a teak mantel shelf near which the lamp is placed, while the shade is covered with the same grass-weave material that papers the wall. You can't beat that for a match!

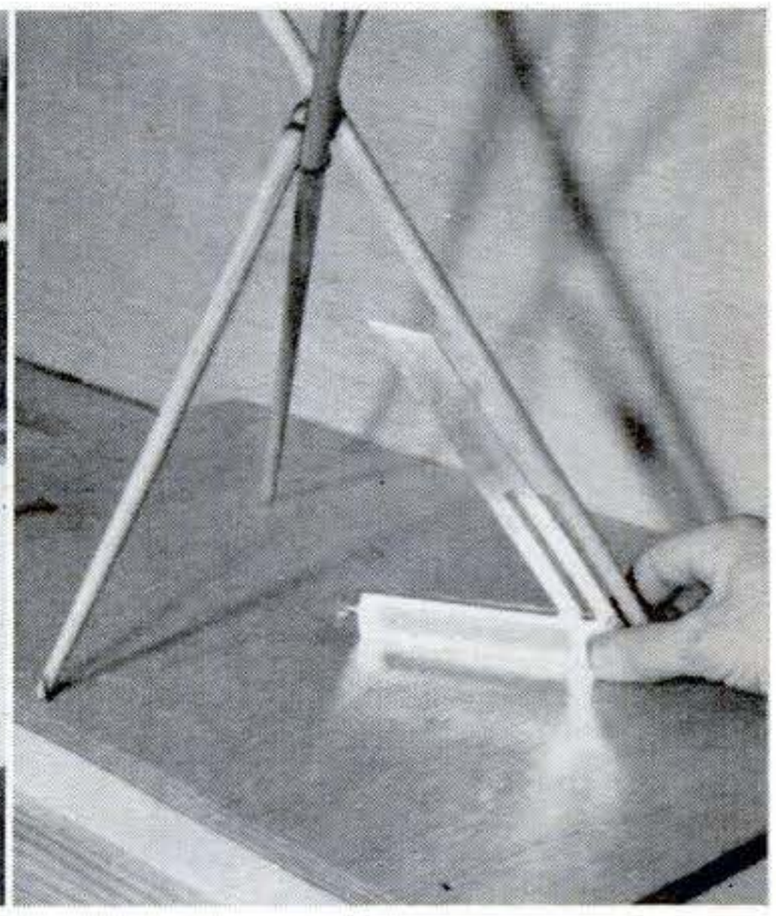
The overall height of the lamp is 26″. The shade is 10½″ deep, with a diameter of 19″. Light is from a 150-watt reflector flood mounted upside down. The only tricky part of the construction is boring the angled holes through the truncated triangle that holds the three spindles in a tripod position.



1 SCRAP TEAK is ripped into three strips ½″ square and 25″ long. Corners are rounded with a chisel or plane, and a blunt starting end is whittled before the strips are driven through a 9/16″ threaded nut to shape them into rough dowels.



2 SPINDLES ARE TURNED on the lathe and sanded with very coarse garnet paper to make finished legs 22″ long, tapering from ½″ in the center to ¼″ at the ends. Then they are removed and the mounting stock is trimmed from each end.



3 FEET ARE TACKED ON to the points of an equilateral triangle laid out on flat surface. Legs are temporarily wired together at centers to hold tripod while the angle to horizontal inside the leg is transferred and set accurately on a T bevel.

CONTINUED

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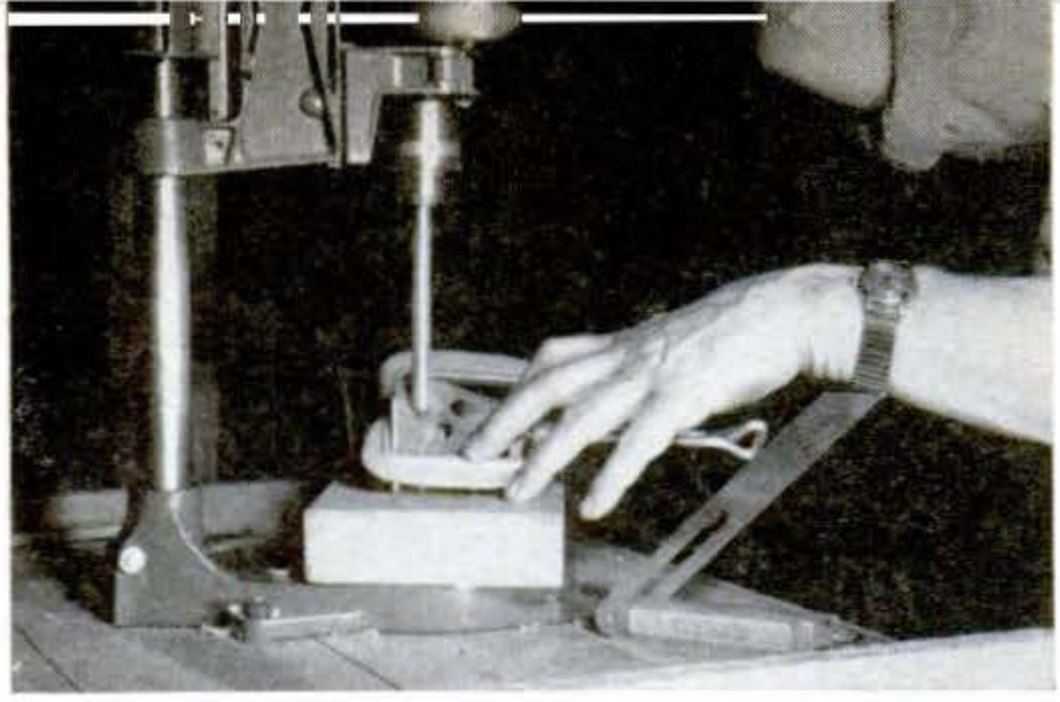
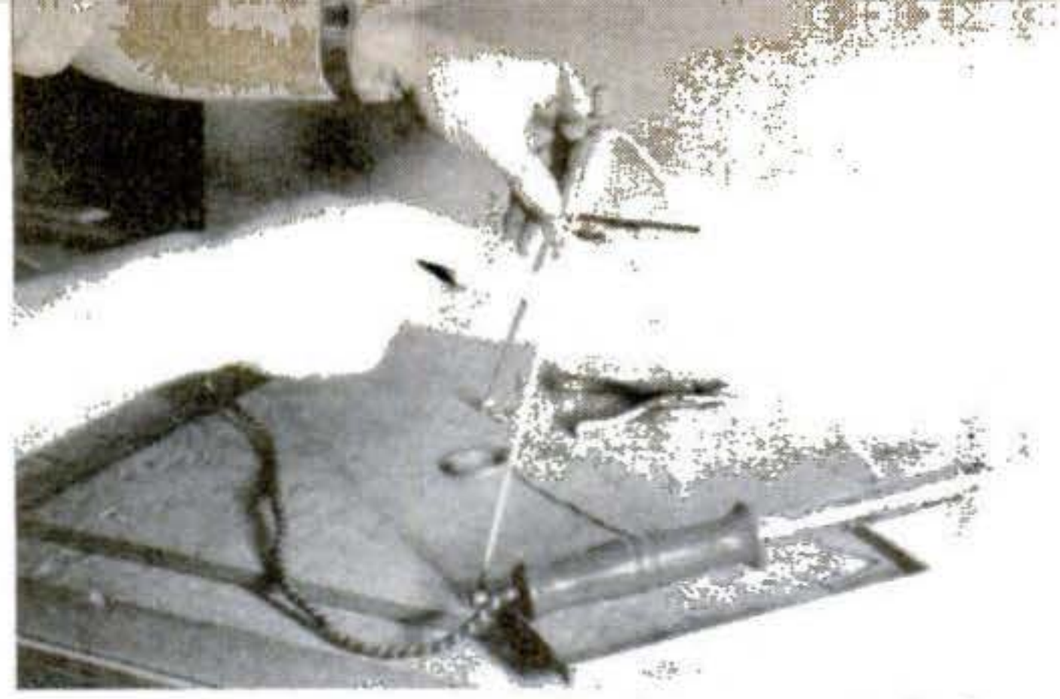
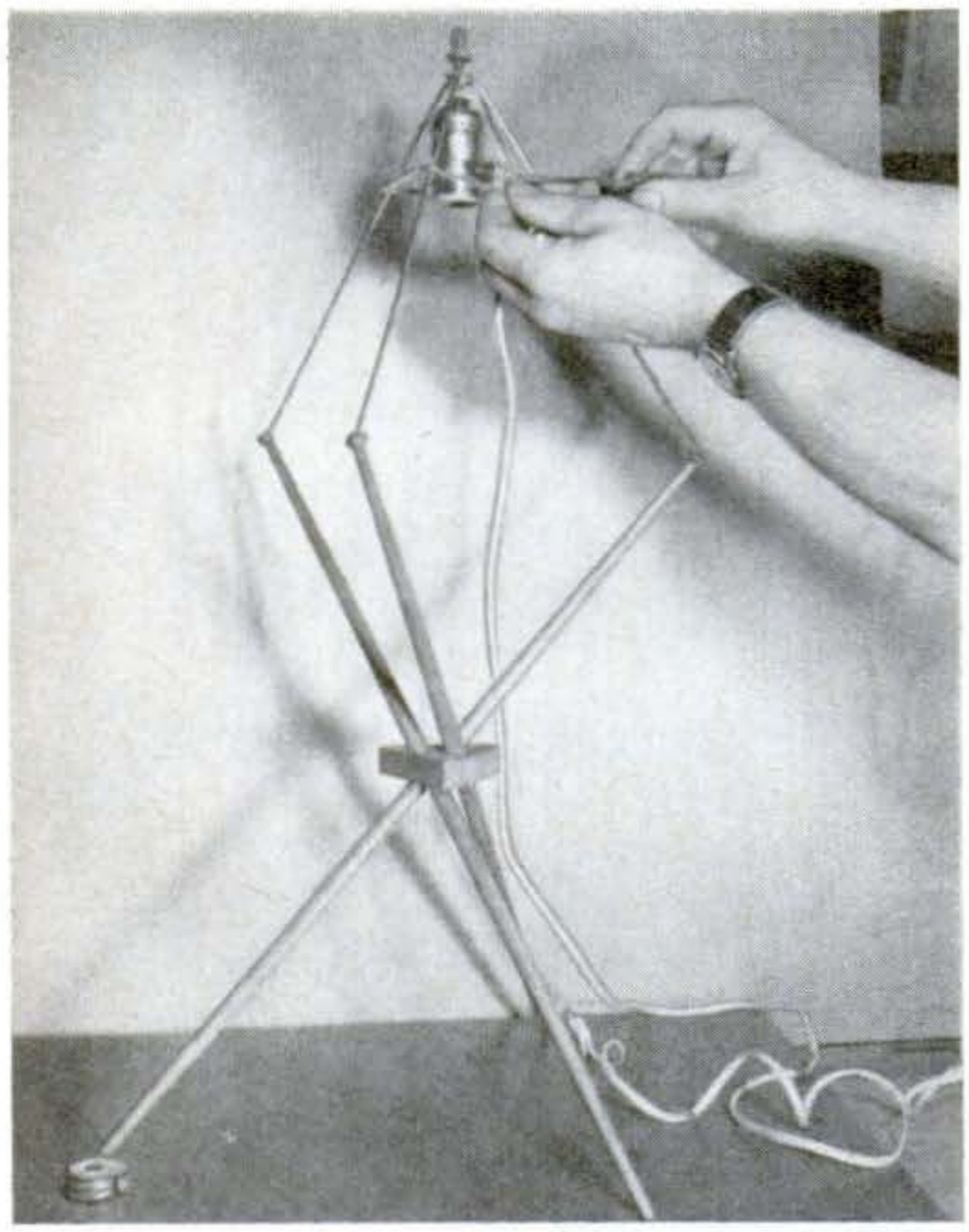


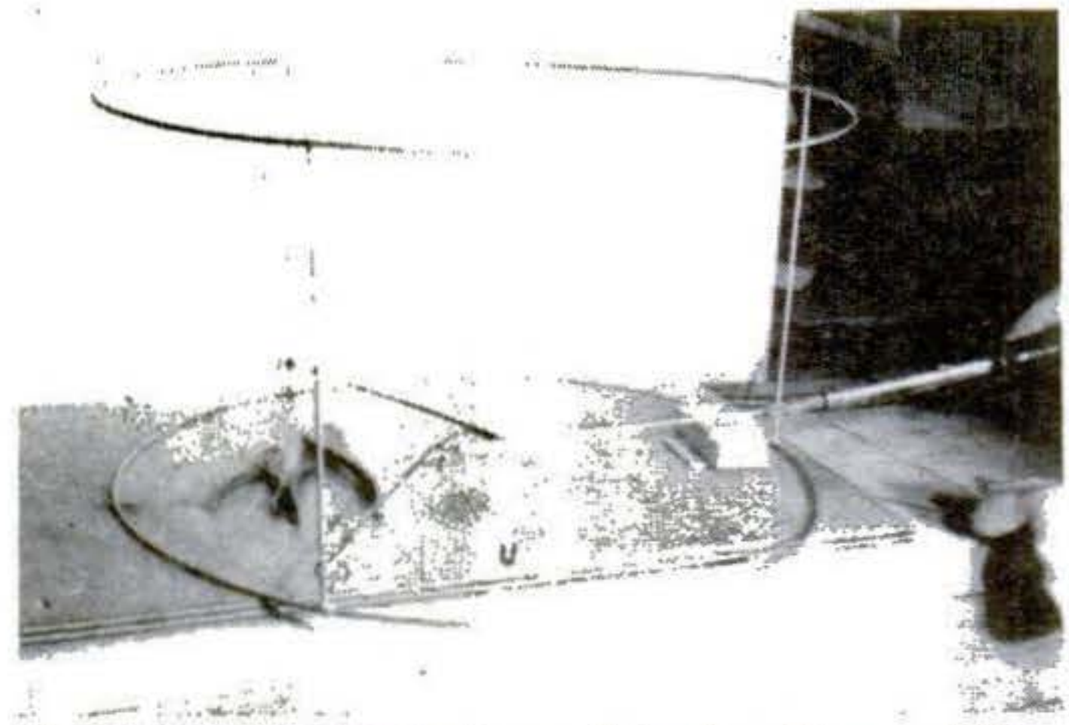
4 CENTER TRIANGLE of ½" teak is tilted at previously determined angle to ½" drill. Piece must be moved for each hole. Vise consists of scrap wood and C clamps. Holes must be spaced not to intersect. Legs are glued in place.



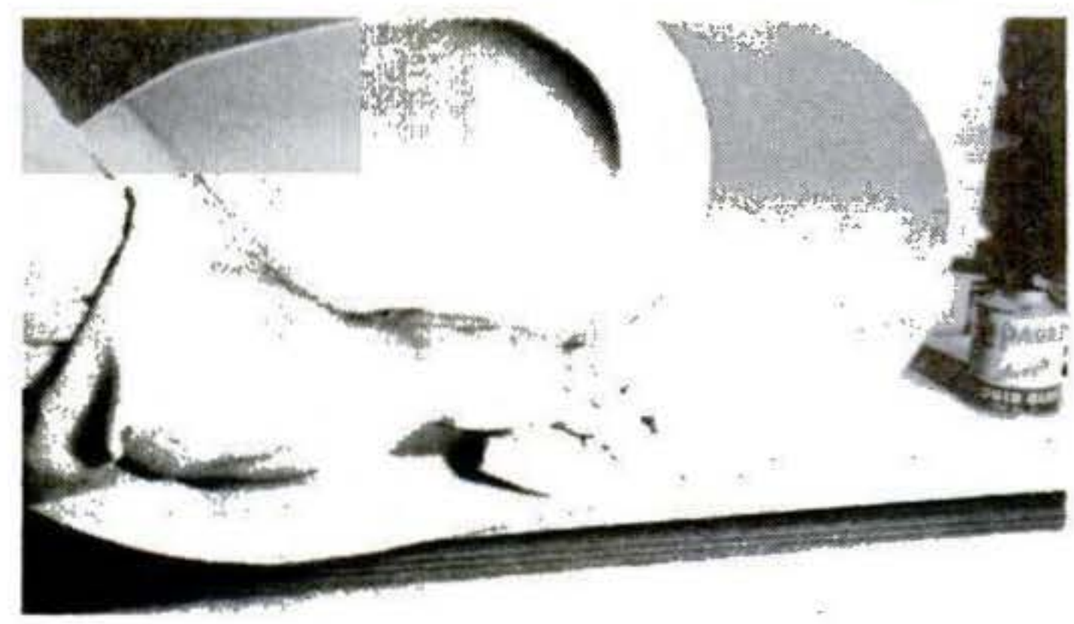
5 UPPER FRAME and socket loop are made from ⅛" brass welding rod. Ribs are soldered to inverted brass bolt (with finger nut) at top and to three brass nuts at feet (set on triangle layout). The joints are then filed clean.



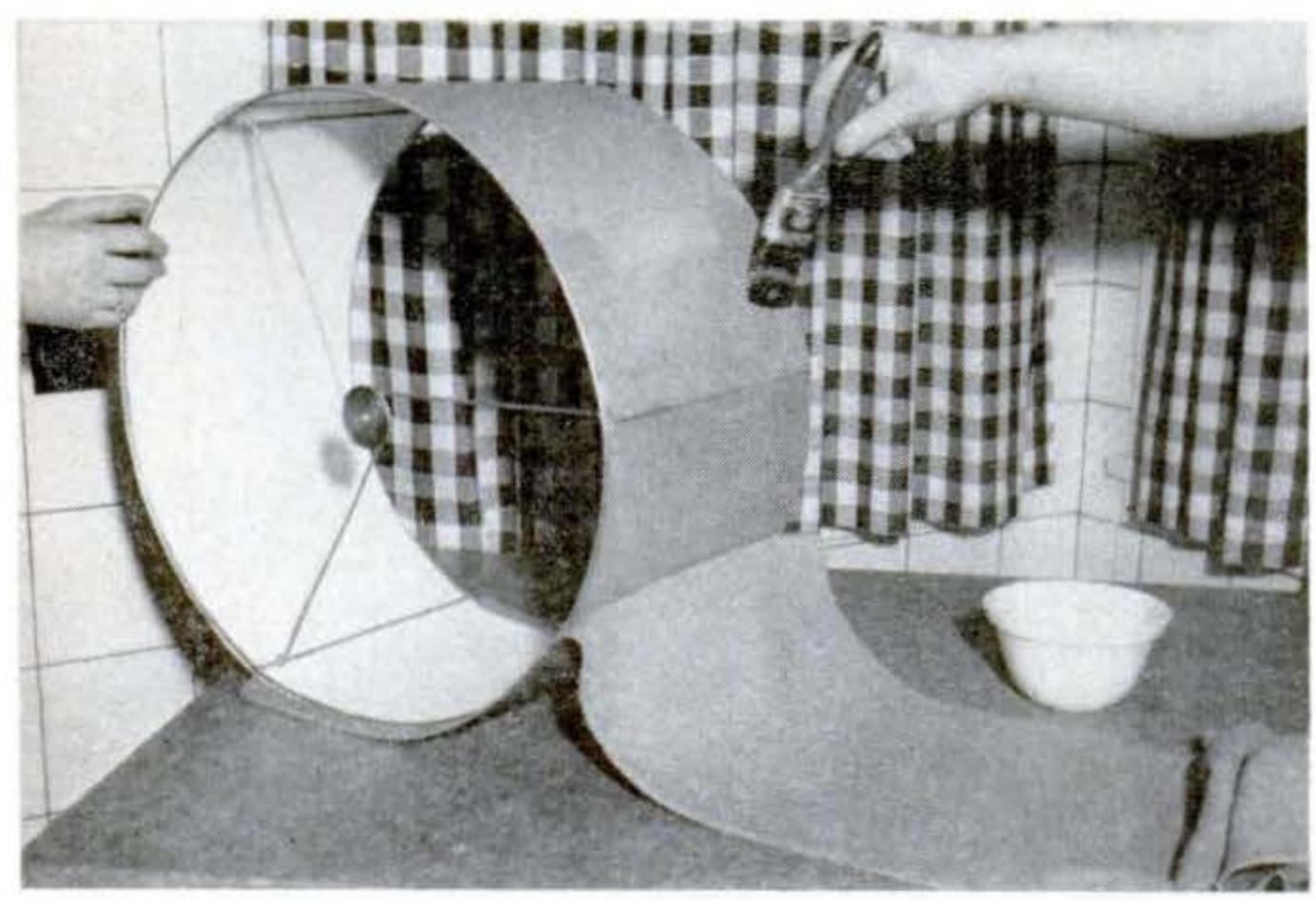
6 BASE IS JOINED by driving small brass screws through nuts and into tripod legs. Bolt and nut draw loop tight to clamp inverted socket. Cord is wired to frame to clear bulb and is passed through hole in center triangle.



7 SHADE FRAME is formed by bending welding rod around line of tacks driven along circumference of layout circle. Overlaps are tapered to avoid clumsy solder joint. Support ribs meet at brass disk drilled for frame bolt.



8 THIN ART BOARD forms shade lining. Shape can be determined by rolling wire frame on sheet of board and tracing path with pencil. Lap joint 2" and glue together. Liner must be snug fit to stay in place while the cover is being fitted.



9 SHADE COVER matches texture, complements color of wall. Material extends 1" at top and bottom, is folded over brass rim and covered with narrow strip of art board. Wallpaper adhesive holds shade cover and finish strips in place.

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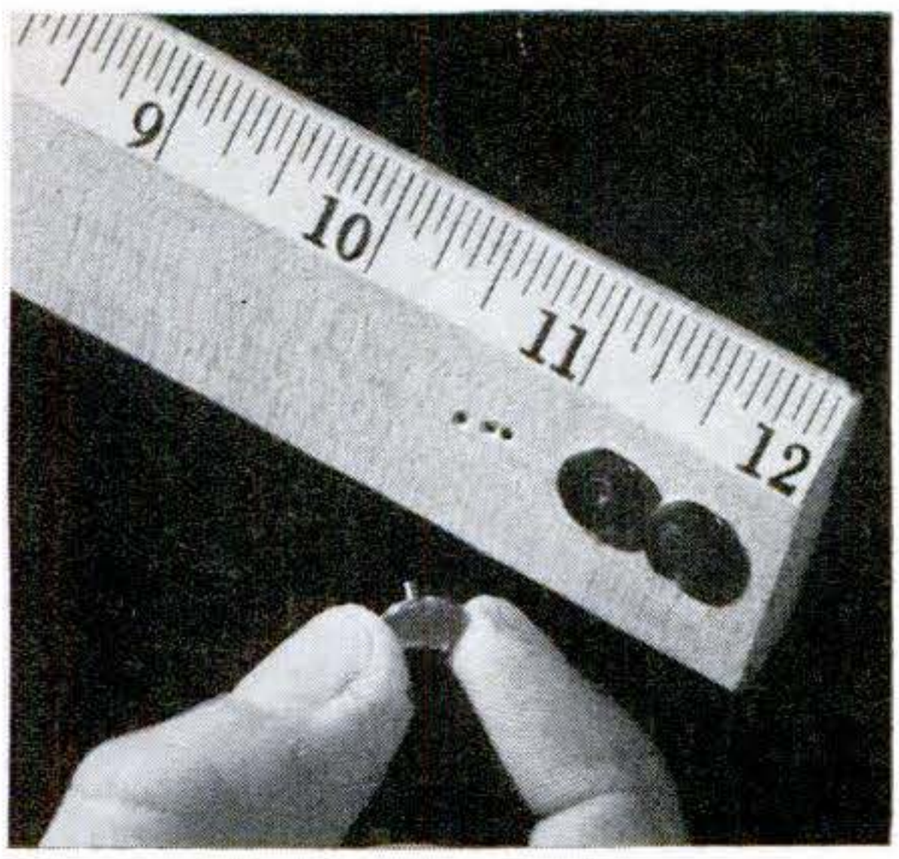
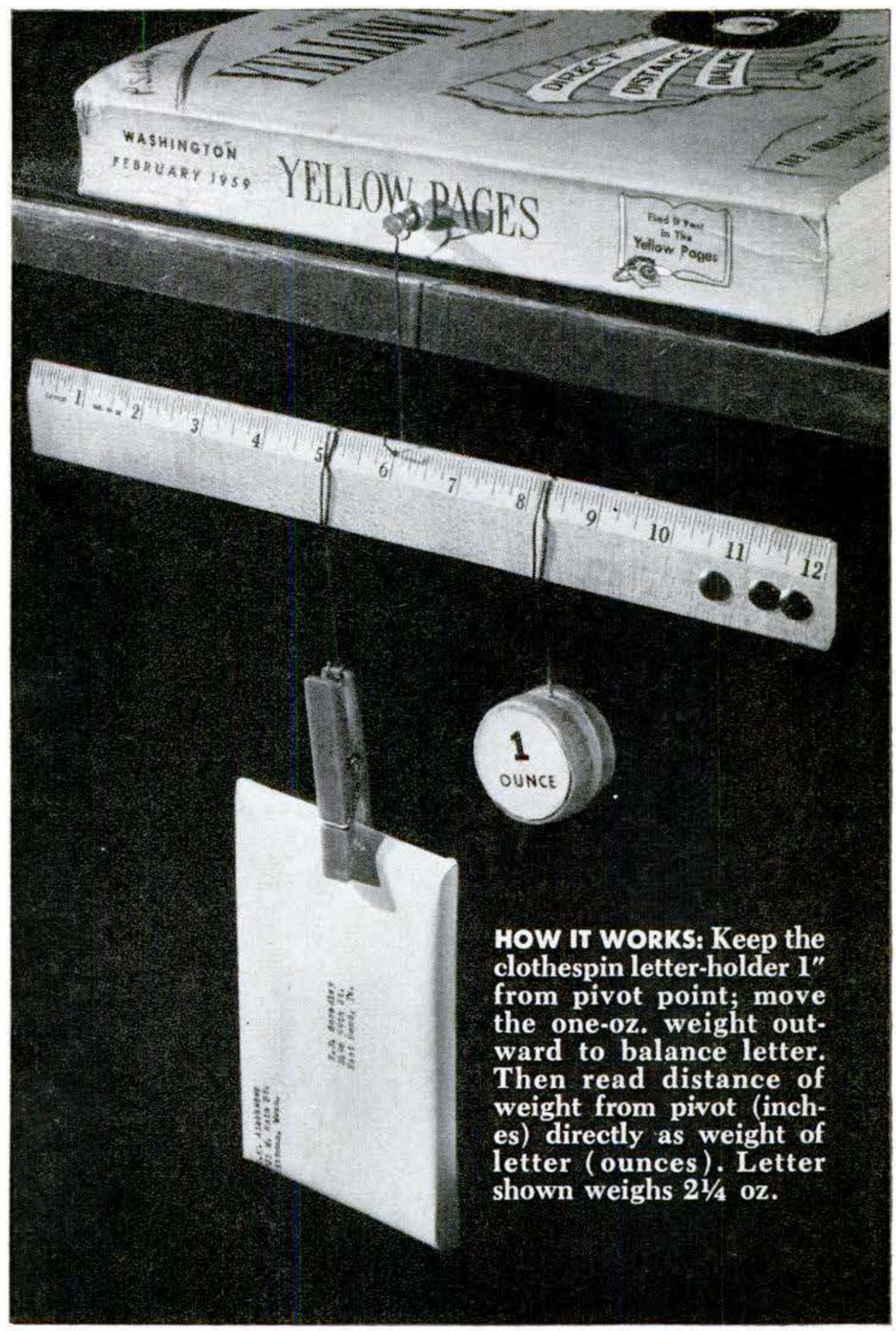


FOR DIRECT READING of scale you must balance out the weight of the clothespin and its hook. Put tacks in the counterweight end until the ruler accurately balances with pin and hook in place.

COUNTERWEIGHT is a paper pillbox containing easy-to-adjust modeling clay. Imbed the paper-clip hanger in the clay, then check total weight of the assembly on a reliable postal or grocer's scale.



HOW IT WORKS: Keep the clothespin letter-holder 1″ from pivot point; move the one-oz. weight outward to balance letter. Then read distance of weight from pivot (inches) directly as weight of letter (ounces). Letter shown weighs 2¼ oz.

Simple odds and ends make an accurate—

Desk-Drawer Postal Scale

EVER wonder how many stamps to put on an extra-heavy letter? You probably had the answer in your desk drawer. That's where you find parts for this balance beam—a ruler hung on a paper clip.

It depends on a law of physics which says that weight on one end of a balanced lever, multiplied by its distance from the pivot, equals weight multiplied by distance on the opposite side of the pivot.

In this case, the one-oz. counterweight and the 1″ spacing of the letter hanger from the pivot, are constants. The missing two elements therefore will be identical numerals, and you can read the weight of a letter as ounces—the distance in inches of the counterweight from the pivot.—*Frank Shore.*

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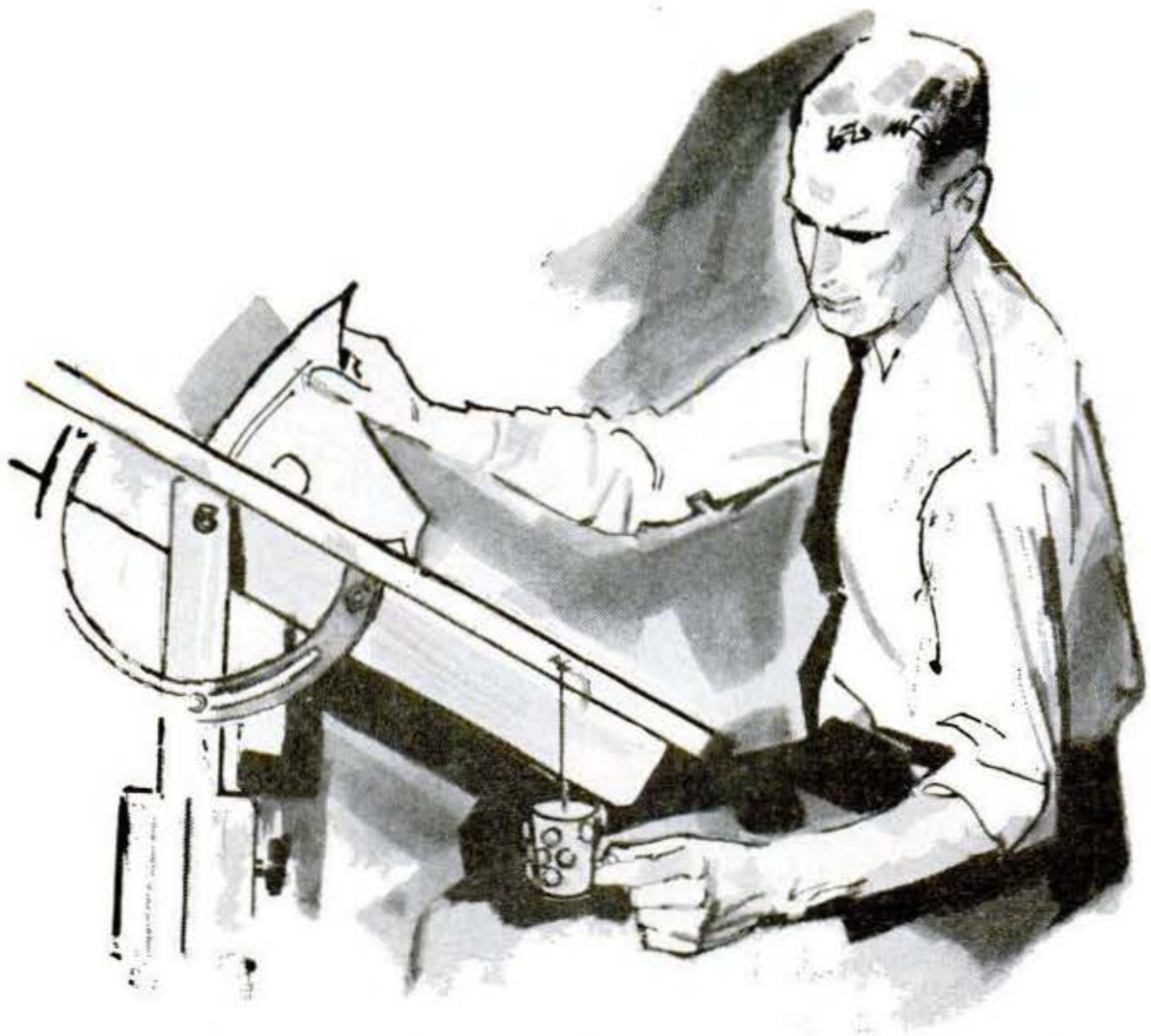
Short Cuts and Tips

FROM PS READERS

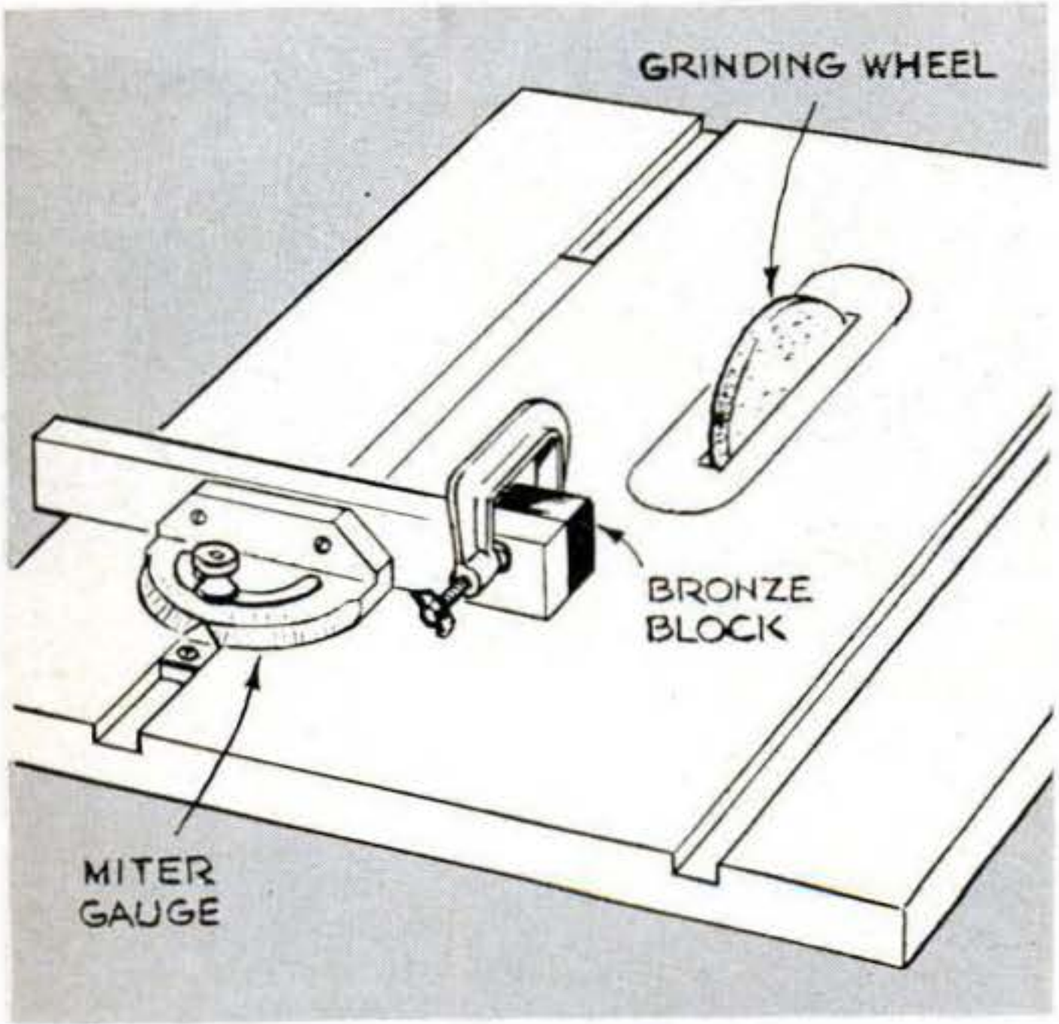


A Handy Holder for Thumbtacks

ANYONE who works at a drawing board knows how easy it is to knock over a box of thumbtacks. You can prevent this annoyance by attaching a large cork from an old thermos bottle to a 6″ length of string tacked to one corner of the board. Stick the thumbtacks into the cork, ready for use.—*K. Enochs, Glendale, Cal.*

▶▶▶TO KEEP paint that you're not going to use right away, reverse the can every few days. This keeps the ingredients in suspension until you're ready to paint.—*Bil Toman, Palatine, Ill.*

▶▶▶PEELING onions can be made a tearless job if you wear a pair of underwater swimming goggles. Your appearance may startle the family, but it works.—*Mrs. Sam Churchill, Yakima, Wash.*



Grinding Bandsaw Guides

WORN bandsaw guide blocks can be reground to original squareness on a table saw. Replace the blade with a grinding wheel or sanding disk, and use the miter gauge as guide. Clamp the blocks to a piece of wood for good bearing against the miter gauge. Re-install the guides with a blade clearance about equal to the thickness of a newspaper sheet.—*King Basham Jr., Linden, Tex.*

Mat Under Shoeshine Kit

SHOE polish and wax on hardwood floors are difficult to remove. As a protection, I keep a decorative linoleum mat handy, to place under my shine kit.—*R. M. Woodbury, Natick, Mass.*

▶▶▶TURPENTINE added to a pan of water makes removal of wallpaper easier and faster. Use a few teaspoonfuls, and brush it on.—*T. Yeager, Somerville, N. J.*

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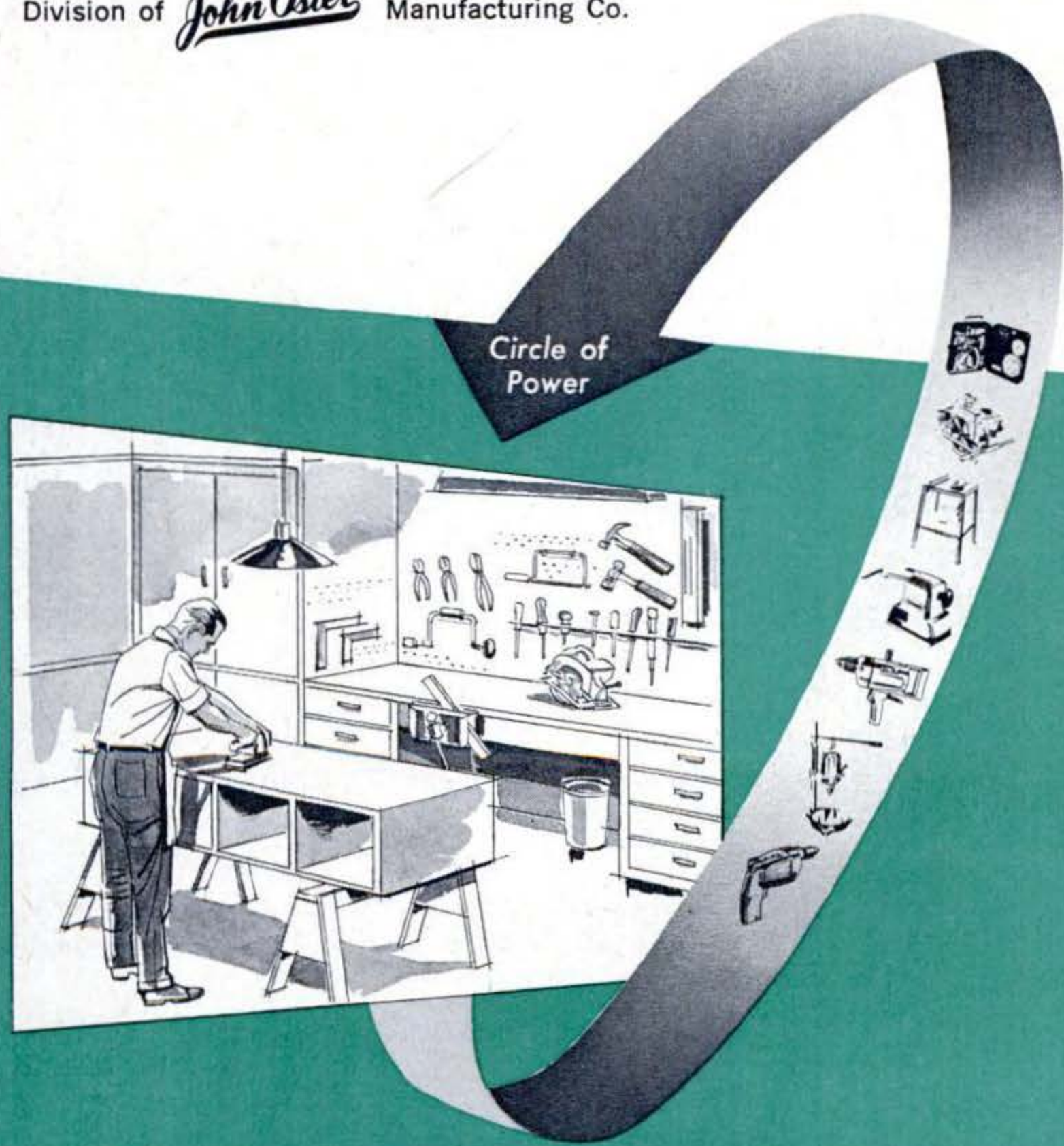

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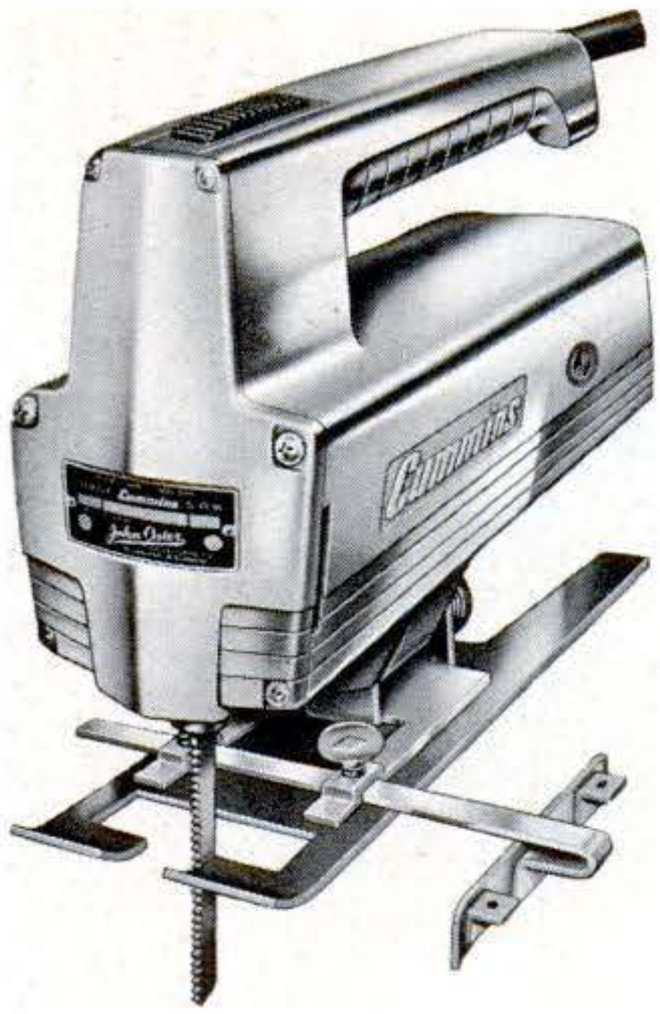
You're ahead two ways with Cummins Hardware Week Special!

CUMMINS CIRCLE OF POWER



Cummins

"PAY-OFF POWER" PAIR

BUY Cummins Sabre-Jig Saw for only $44.95 . . .

GET this new Sabre-Jig Saw Table FOR ONLY $2 more!

(Table retails for $9.95 after Hardware Week.)

CUMMINS 466-11 SABRE-JIG SAW — NO VIBRATION . . . with exclusive automotive cam drive. Combines all the features of rip, crosscut, band, keyhole, hack, jig and scroll saws. Hairline precision in cutting plywood, plastics, leather, metal. Ideal for home workshop, plumbers, electricians, pattern makers, fabricators, carpenters, heating installers.

You're ahead in time and labor savings — ahead in the extra uses you'll find for your Cummins Sabre-Jig Saw when you team it with this brand-new Saw Table. With a working surface of 88 square inches, it converts your Sabre-Jig Saw to a versatile bench saw . . . retains full cutting capacity (cuts a 2 x 4 at 45° angle, with proper blade).

Easy Angle Cuts

Variety of Cuts

Starts Its Own Hole

Handy Heel Rest

Built to sell for $9.95, the handy Saw Table is yours for only $2.00 when you buy the Cummins Sabre-Jig Saw in Cummins "Hardware Week" Special. *Show this book to your Cummins dealer to qualify for this offer!*

CUMMINS 625-01 SABRE-JIG SAW TABLE — adds bench saw precision in a jiffy. Your choice of 3 easy mountings.

Mounts in vise

Secures with C-clamps

Screws to workbench

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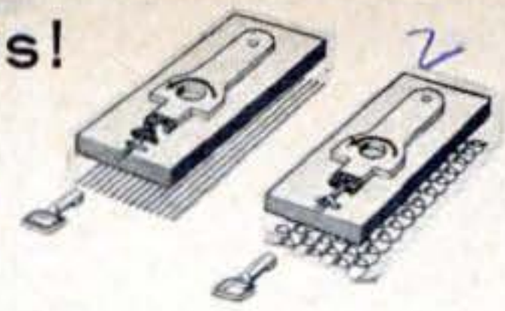
Take the Work Out of Sanding Operations!

Cummins SANDERS



America's Foremost

double action Sander

Gives you fast-cutting Orbital motion and professional Straight-Line motion at the turn of a key! Non-slip timing belt drive assures trouble-free performance, long life. Universal AC-DC motor has double-coil dynamically balanced armature.

Standard Finish — orbital action gives ideal results for preliminary and standard sanding.

Super-Fine Finish — straight-line motion is perfect for final finishing and end sanding without chipping or flaking.

Model 476-01 **$49.95**

orbital Sander

Model 469-01 **$39.95**

Direct-drive powerful induction motor with exclusive enclosed counterweight assures long life, vibration-free sanding. Easy abrasive change, removable auxiliary handle.

straight line Finishing Sander

Model 454-01 **$16.95**

Designed for fine finishing work, with powerful double motor construction for long, troublefree operation. Ideal for flush sanding; doubles as buffer and polisher, too.

Prices slightly higher in Canad

MARCH 1

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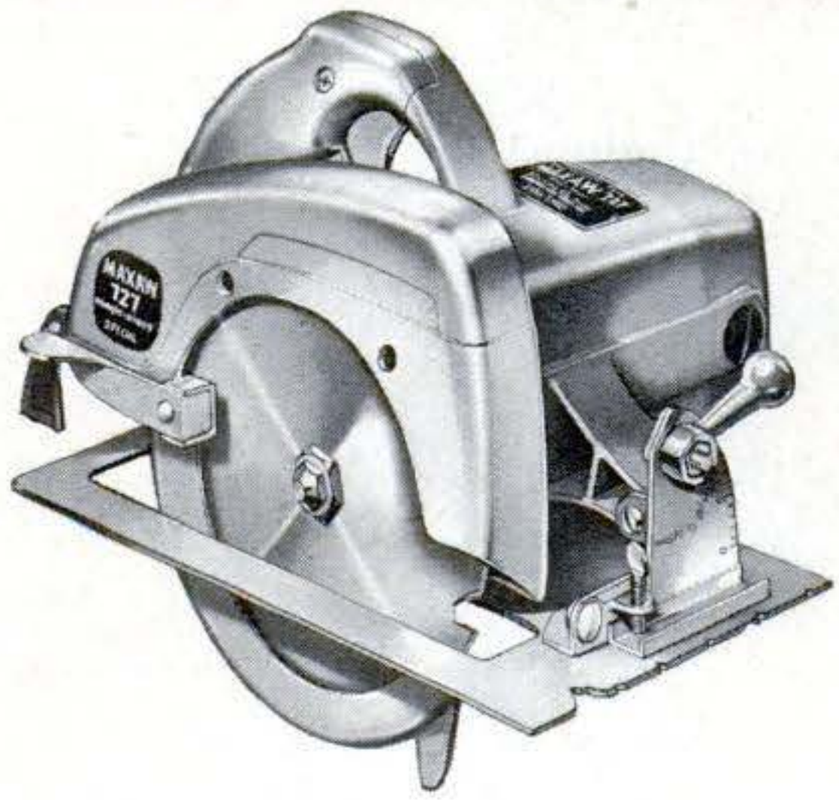
Cummins MAXAW®

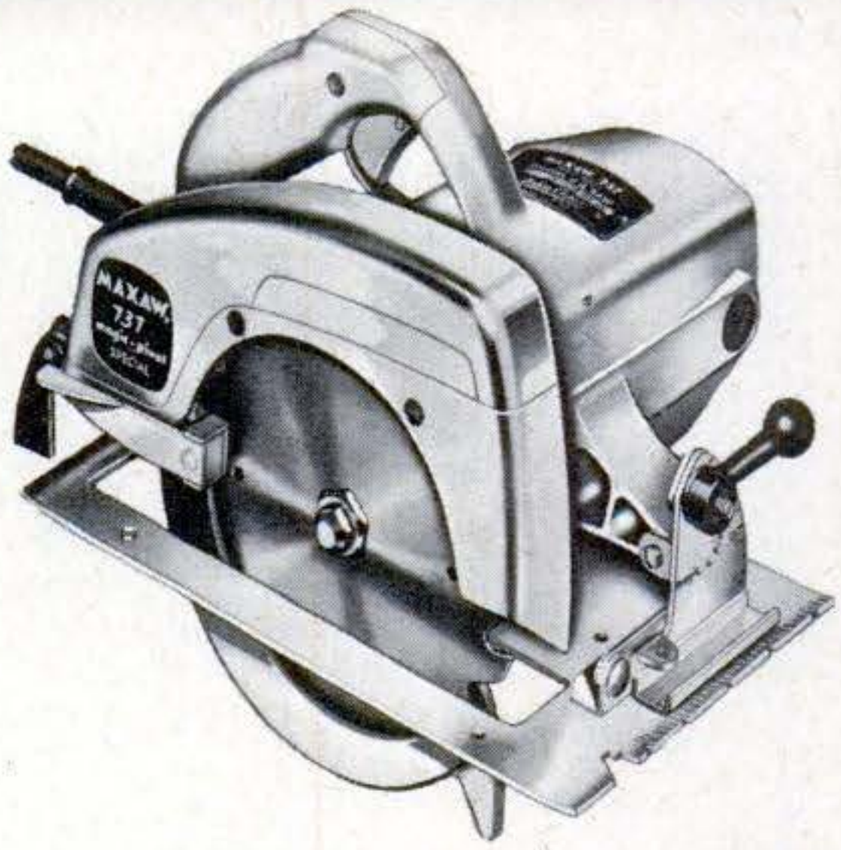
cut every sawing task down to size!



MAXAW 727-01 — $49.95

7" CUTTING CAPACITY

Precision-built to Cummins high quality standards of long life and performance . . . but priced attractively low! Cuts 2" dressed lumber at a 45° angle. Complete with telescoping safety guard, many other MAXAW features.



MAXAW 737-01 DELUXE — $59.95

7" CUTTING CAPACITY

King-sized cutting performance and partial ball bearing construction make this saw a "must" for the semi-professional craftsman. Powerful motor assures troublefree operation in the hardest woods. Cuts 1⅞" at 45° — 2⅛" at 90°.

Prices slightly higher in Canada.

MAXAW 777-01 SAW TABLE — $39.95

Converts any MAXAW (except 7800-01) into a precision tilt arbor table saw — **in only five seconds!** Machine finished oversize table top measures 20" x 24"; table is 34" high, of all-steel construction. MAXAW saw shoe becomes part of table top to retain full cutting capacity. Included are: Cam-Lock rip fence, calibrated miter gauge, MAXAW trigger lock, switch and outlet box.

EXCLUSIVE MAGIC PIVOT

Deeper Cuts . . . More Power at Cutting Edge . . . Cuts 2" Dressed Lumber at all Angles with Blade to Spare.

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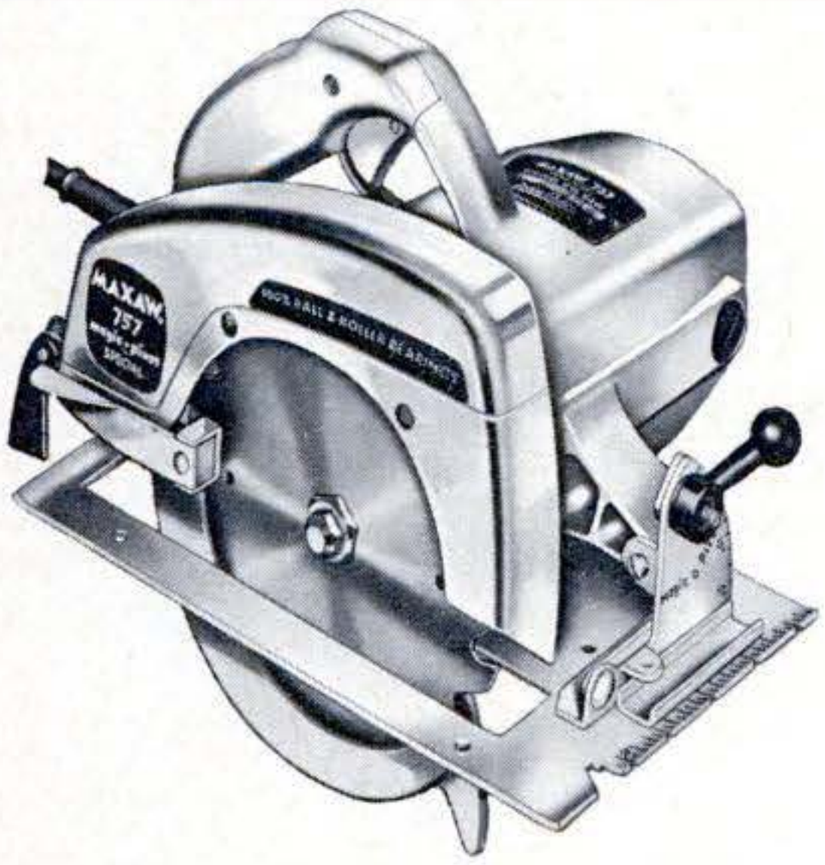
ONLY MAXAW HAS ALL THESE PROFESSIONAL FEATURES:

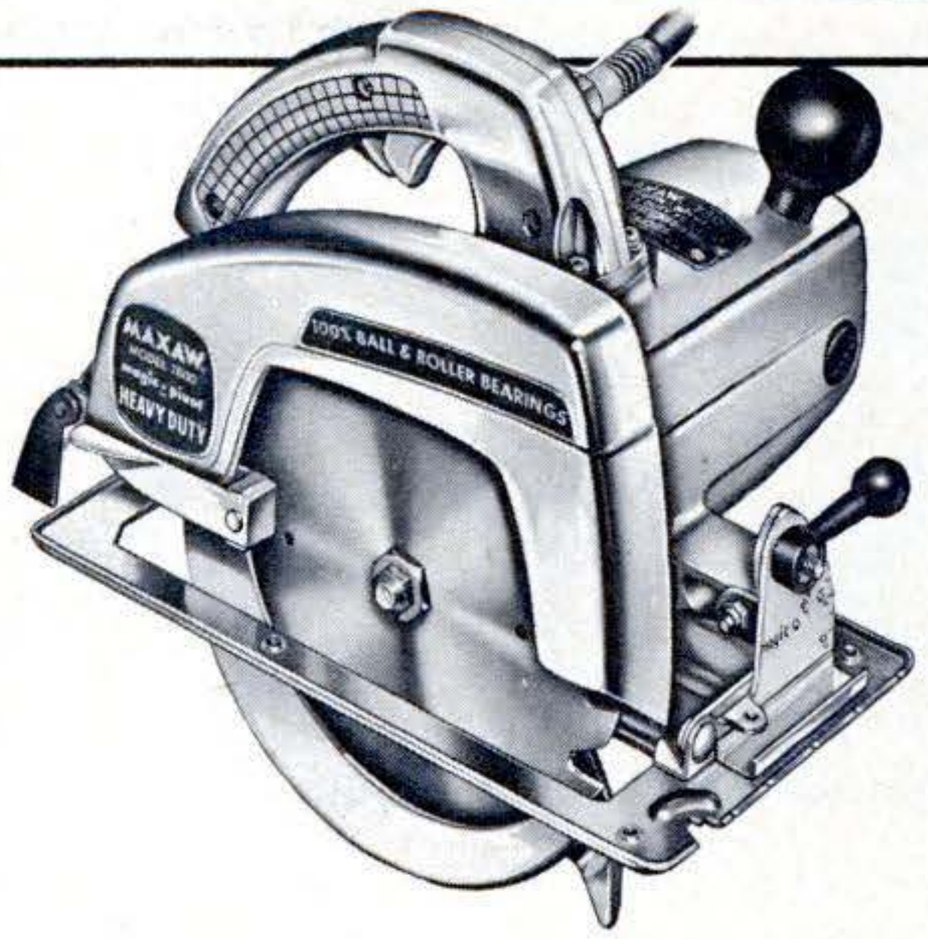
Magic-pivot for deeper angle cuts with blade to spare . . . True-Course Guide to keep blade on line, keep cut open . . . Pedestal Base for easier blade changing . . . Telescoping Safety-Guard with Safety Lever, snap-back blade shielding action . . . Clutch Blade Action to eliminate kick-back, prevent blade and motor damage . . . Calibrated Bevel Adjustment, Blade Sighting Slot, Full-Size Saw Shoe.



MAXAW 757-01 CUSTOM — $69.95

7″ CUTTING CAPACITY

100% ball and roller bearing construction for the toughest cutting jobs! Designed for industrial construction — the only saw you need to build a complete house! Cuts 1⅞″ at 45° — 2⅛″ at 90°.

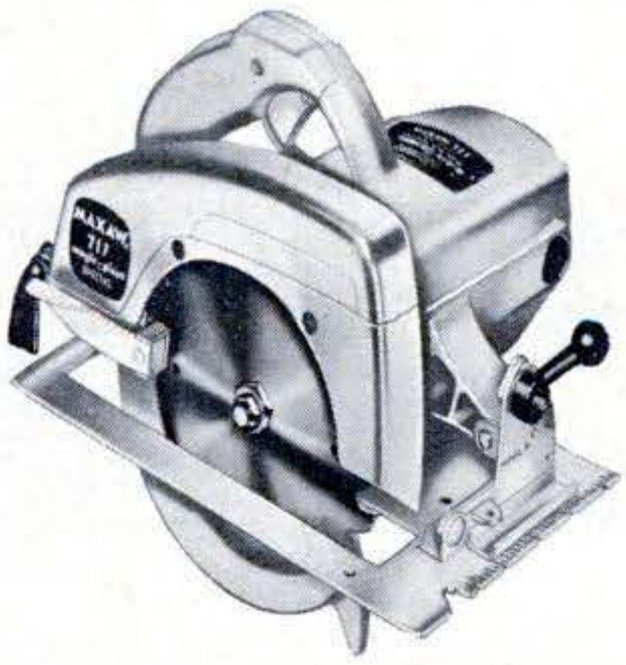


MAXAW 7800-01 POWER-HOUSE

$84.95 8″ CUTTING CAPACITY

Built for downright brute strength. All ball and roller bearing construction for tough jobs that require maximum power and cutting capacity, continuous duty operation. Cuts 2⅛″ at 45° — 2½″ at 90°.

SPECIAL MAXAW OFFER!



MAXAW 717-01 SPECIAL

Regularly $49.95 —
NOW ONLY $37.50!

Value leader of the power saw field, incorporating all the features of a professional saw at half the price! Ideal for the home craftsman, equals the cutting capacity of a 7″ saw!

Show this book to your Cummins dealer to qualify for this special reduced-price offer!

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Shop Tested—Job Proved

for home, farm, factory!

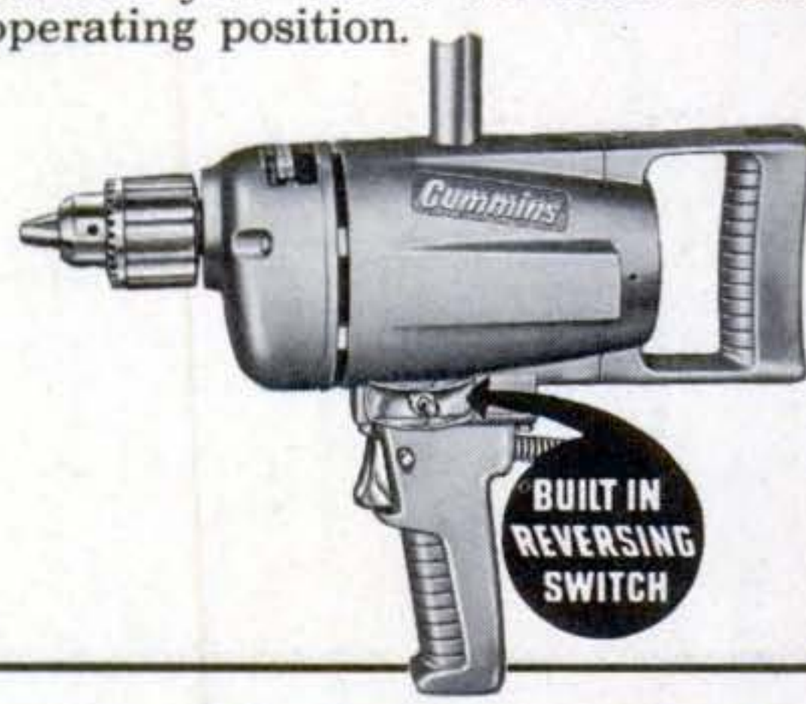
Cummins 1/2" ELECTRIC DRILLS

Here's husky Pay-Off Power for construction and maintenance jobs in the factory, farm or home! Comfortable, balanced design with two-position removable handle lets you choose the most convenient operating position.

336-01 STANDARD REVERSIBLE $49.95. Built-in Reversing Switch

Ideal choice for deep boring of all kinds. A flick of the built-in reversing switch eases bit out under its own power, instantly, smoothly, to reduce bit breakage.

333-01 STANDARD — A value leader with the superb design, stamina, power and long life you'd expect only in more expensive drills. Same features as above but without reversing switch. $39.95



334-01 DELUXE — $49.95

Ball and self-lubricating bearing construction for power-to-spare drilling capacity on tough jobs. The shop mechanic's favorite wherever accurate, dependable work is needed.

335-01 CUSTOM INDUSTRIAL $64.95

Superbly engineered for endurance and added performance on every job, this model features **100% ball and roller bearing construction** for continuous heavy-duty service.

338-02 INDUSTRIAL — top choice for heavy-duty work. All ball and roller bearing construction, with **built-in reversing switch** to ease bits out of deep holes under power. $74.95

Prices slightly higher in Canada.

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Drill-of-a-Lifetime Performance!

Cummins 3/8" and 1/4" DRILLS

Perm-Align Gearing . . . an exclusive gear mounting found in all Cummins 1/4" and 3/8" drills. Gears maintain perfect alignment even if accidentally jarred.

318-01 COMMERCIAL 3/8" DRILL — $39.95

A "must" for field mechanics and home craftsmen, combining extra power and capacity with the ease of handling of a 1/4" drill. **Ball and self-lubricating bearing construction** with super-powered motor for the right speed for all 3/8" drilling applications!

306-01 CUSTOM 1/4" DRILL — $34.95

Leads the 1/4" drill league in power, performance and stamina . . . tops for drilling wood, metal, stone, tile, concrete and plastics. **Ball and self-lubricating bearing construction** for long life.

305-01 DELUXE 1/4" DRILL — a versatile pistol-grip drill that combines quality, performance and price . . . perfect partner for any home workshop. $29.95

304-01 STANDARD 1/4" DRILL — $24.95

This is a full-powered drill, precision built for trouble-free performance. Shorter, more compact design makes this drill easy to handle overhead or in small cramped spaces.

"Man-Wanted" Time and Labor Savers!

Cummins PORTABLE DRILL KITS

305-21 Deluxe 1/4" Workshop . . . superb performance, superb value in a drill-saw kit. Super-power drill, 4" saw attachment, quality accessories for home repair jobs. $39.95

Every craftsman appreciates these worksaving workshops by Cummins, available in a variety of combinations of drills and accessories to meet every workshop need, every performance requirement! In hip-roof or handy "Organizer" cases that take the whole kit to the job or hang on workshop wall.

Cummins Drill Kits Priced From $29.95 to $54.95

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Cummins PORTABLE TOOLS CKD

These Leading Dealers Will Show You the Way to "PAY-OFF POWER"

CALIFORNIA

Antioch, Howse Hardware Co.
Arcadia, Henry's Hardware
Arcata, Hensel Hardware
Atwater, Passadori Hardware
Azusa, Victor's Paint
Barstow, Cecils Paint & Hardware
Bellflower, Bell Hardware
Belmont, Belmont Hardware
Big Bear Lake, Craven Building Material
Ceres, Ceres Hardware
Chowchilla, Perry Hardware
Clovis, Deavers Hardware
Coalinga, Canaday's
Coalinga Hardware Co.
Crockett, Pedrotti Hardware Co.
Denair, Denair's Hardware Co.
Dos Palos, W. M. Mumby Hardware
Downey, Downey Lumber
R. E. Stanfield
El Cajon, Glenview Supply
El Monte, Crawfords Modern Village Stores, Inc.
El Sobrante, Oliver's Hardware
Escalon, Strand Bros. Hardware
Eureka, Shafer's Hardware
Fairfield, Evans & Pyle Hardware
Farmersville, Lane's Hardware
Firebaugh, Firebaugh Appliance & Hdwe.
Fremont, Dale Hardware Co.
Fresno, Easton Lumber & Supply
National Lumber Co.
Rhodes Department Store
Village Home Hardware Center
Yosemite Lumber Co.
Fullerton, Rogers & Vaughn Hardware
Glendale, City Home & Garden Supply
Grass Valley, Alpha Hdwe. Co.
Guerneville, Guerneville Hardware
Gustine, Azevedo Hdwe. & Implement
Hollister, Brown & Chappell Hardware
Hughson, Hughson Hardware
Huron, Huron Lumber & Supply Co.
Imperial Beach, Baker Hardware
Ivanhoe, Ivanhoe Hardware
Kerman, Kerman Hardware
Lake Arrowhead, Ganahl Lumber Co.
Livingston, Ecclefields Hardware
Los Angeles, Andys Hardware
Bob's Surplus
Broadway Hardware
Los Banos, Hanna Hardware Co.
Madera, Madera Lumber & Hardware
Manteca, Hardware Mart
Martinez, L. M. Lasell Co.
Mendota, Westside Hardware
Merced, Merced Hardware Co.
Modesto, Stanilaus Implement & Hardware
Monterey Park, Garvey Hardware
Moorpark, Moorpark Milling & Hardware
Morgan Hill, Squeri Bros. Hardware
Nevada City, Alpha Hdwe. Co.
Norco, Taylor's Builders Mart
Novato, Pini Hardware Co.
Oakland, Ellis Hardware Co.
Paradise, Paradise Hardware
Parlier, Parlier Lumber Co.
Patterson, Patterson Hardware
Petaluma, Rex Hardware Company
Placerville, Fisher Hardware Co.
Pomona, Wiloma Custom Built Screen & Power Tool Distr.
Porterville, Jones Hardware
Red Bluff, Lyon-Garrett Co.
Redlands, Dickinson Hardware
Redwood City, Imperiale Hardware Co.
Reedley, Nachtigall's Home & Auto
Ripon, Schemper Hardware
Riverdale, Brown Hardware
Riverside, Better Homes Industries
Rodeo, Curley's & Son Hardware
Sacramento, Sherrock's Hardware
Saint Helena, Central Valley Builders Supply
San Bernardino, Tom Fergen Hardware
San Bruno, Rhoads Hardware Co.
San Carlos, Star Hardware Co.
San Diego, Resner Hardware
Whitney's Department Store
San Francisco, Center Hardware Co.
Howse Hardware Co.
G. B. Jackson & Son, Inc.
L. R. Jackson Homewares
Lakeside Hardware & Lumber
Levin's Auto Supply
MacKillop Hardware Co.
Ocean View Hardware
Portola Hardware & Appliance
Sanger, Wagner Hardware
San Jose, Farmer's Union Hardware
Thoeny Bros. Hardware
San Leandro, Lind Hardware Co.
San Lorenzo, Manor Hardware
Stockton, Dunlap Hardware
Fremont Hardware Co.
Sunnyvale, Cherry Chase Hardware
Tranquillity, Hanson Bldg. Materials Supply
Turlock, Monteith Tractor & Truck Co.
Turlock Hardware
Ukiah, Portlock Hardware Co.
Upland, Upland Lumber Co.
Vacaville, Pacific Hardware Co.
Vallejo, Walker's Supply Co.
Whittier, Kietas Town & Country Hardware
Willows, T. W. Ward Hardware
Woodlake, Woodlake Hardware Co.
Woodland, Cranston Brothers
Yucca Valley, Yucca Valley Lumber Co.

COLORADO

Arvada, J. W. Metz Lumber Co.
Ray's Hardware
Cedaredge, Cedaredge Lumber Co.
Denver, Chase Lumber Co.
Jensen Hdwe.
South Gaylord Hdwe.
Lakewood, J. W. Metz Lumber Co.

CONNECTICUT

Brandford, J. R. Steele Associates
Bridgeport, Central Hardware
Schweizer Hardware
Tunix Hill Hardware
Yurdin Hardware
Bristol, Maple End Hardware
Scarritt Lumber Co.
Colchester, Einhorn Grain
Durham, Coe & Eick
Fairfield, Fairfield Lumber Co.
Hartmann Hardware
Kele Hardware
Poster Hardware
Stratfield Hardware
Greenwich, Scalzi-Wooton Paint & Lumber
Hamden, Centerville Lumber
Hartford, Guthart Inc.
Milford, Builders Supply Co. of Milford
Naugatuck, Western Auto
New Haven, George Shubs
Gurland Hdwe.
New Haven Hardware
Russo Brothers PT
North Haven, Drazen Lumber Co.
Norwich, The Leader Store
Plainville, Plainville Hardware
Ridgefield, The D. F. Bedient Co.
Seymour, Housatonic Lumber
Southington, Neal Hardware
Thompsonville, Western Auto
Trumbull, Tickey's Hardware
Waterbury, Mahler's
Valley Hardware
Watertown, Western Auto
West Haven, Robins Hardware

DELAWARE

Dover, Capitol Hardware Co.
Wilmington, Suburban Hardware
H. H. Ulmer Hdwe. Co.
Wilmington Hdwe. Co.

IDAHO

Grangeville, Madison Lumber & Hardware
Lewiston, Lewiston Clarkston Lumber Co.
Moscow, Standard Lumber Co.
Saint Maries, Economy Hardware
Sandpoint, Bargain Supplies Co.
Littlefield's

ILLINOIS

Bloomington, West Side Coal & Lbr. Co.
DeKalb, Gordon Hardware & Supply
Freeport, Sanford & Zartman Lbr. Co.
Kankakee, H. H. Troup & Co.
Peoria, Hobby Models

IOWA

Clinton, Nelson's Cashway Lumber Co.
Hawarden, Swanson Hardware
Lemars, Sieverding-Walz Co.
Spencer, C. Ben Bjoinstad
Waterloo, R. E. Morris Hardware

MAINE

Berwick, John A. Bell
Mechanic Falls, E. A. Parker Company
Sanford, Colby & Woodman
Wells, A. M. Morse & Sons

MASSACHUSETTS

Abington, Robertson Lumber Co.
Ashland, Ashland Hdwe. Co.
Billerica, Cushman's Hardware
Bridgewater, J. H. Fairbanks Co.
Chelmsford, Harvey Bldg. & Wrecking
Danvers, Line Lumber Co.
Dennisport, Robt. Henderson Supply Co.
East Bridgewater, Dewhorst Lumber Co.
Fairhaven, C. F. Delano, Inc.
Framingham, Monnick Supply Co.
Red's Supply
Harwich, D. T. Bates Co.
Holbrook, The Hardware Centre
Hyannis, Central Hardware
Leominster, Airport Sales & Supply
Marlboro, Lincoln Hardware Co.
North Plymouth, Kingston Lumber Co.

Sandwich, Sandwich Hardware
Shrewsbury, Spags Supply
South Dennis, Leon W. Hall Inc.
South Hamilton, Chittick's Farm Supply
South Yarmouth, South Yarmouth Hdwe.
Tewksbury, Tewksbury Speed & Sport Co.
Waltham, Wal-lex Hardware Co.
Wareham, Edwin L. Morse
Westfield, Home & Garden Shop
West Newton, A. J. Harris Hardware
Willimansett, Aubuchon Paint & Hardware Co.
Worcester, Alan Barry Corp.

MICHIGAN

Ashley, Ashley Hardware
Athens, E. W. Merchant Hdwe.
Battle Creek, Snyders Hardware
Belding, Belding Hardware
Carson City, Barnes Hardware
Charlotte, Charlotte Hardware
Chesaning, Gewirtz Hdwe. & Appl.
Decatur, Slack's Hardware
Detroit, Federal Merchandise Mart, Inc.
Fenkel Hardware
Warwick Hardware
Elsie, Darling's
Frankfort, Deo Courville Lumber
Grand Haven, Cook Hdwe. & Plbg.
Grand Rapids, Andringa's Hdwe. & Appl.
Godwin Hardware
Stryker Hardware
Thompson Hardware
Hudsonville, Gemmens Hardware
Ionia, Stones Firestone Store
Ithaca, Larry's Hardware
Jackson, Barber's Hardware & Bike Shop
Kalamazoo, Goggin Co.
Miller Lumber Co.
Lake City, Van's Building Supply
Manistee, Wahr Hardware
Manton, Manton Hardware
Marshall, Mitchell Hardware
Middleville, Norman Hardware
Muir, Muir Hardware
Orchard Lake, Wells Hardware
Owosso, Pabst Bros. Hardware
Oxford, Tunstead Hardware
Pontiac, Tom's Hardware
Portage, Portage Lumber Co.
Rochester, Burr Hardware
Saint Clair Shores, Superior Feed and Supply
Saint Johns, Alan R. Dean Hardware
Scottville, Wissner's General Store
South Lyon, Gates Hardware
Stanton, Bernie's Hardware
Warren, Leonard's Hardware
Weidman, Fox Hardware
White Cloud, A. Q. Adams Hardware

MINNESOTA

Bagley, Bagley Mercantile Company
Bemidgi, Swedmark Hardware
Big Fork, Bunnell's Hardware
Blackduck, Nendick Hardware
Blooming Prairie, Ille Hardware
Brewster, Brewster Hardware
Chisholm, Centa Hardware
Crystal, The Building Block Inc.
Ely, Lynn Hardware & Furniture Co.
Gibbon, O. N. Johnson Co.
Grand Rapids, Mills Lumber Company
Grey Eagle, Peschel Hardware
Hawley, Quirt Hardware
Holdingford, Pogorelc Hardware
Janesville, Vinson Hardware
Kasson, Beaver Hardware
Lake Benton, Marti Hardware
Le Sueur, O'Brien Hardware
Minneapolis, Hardware Hank Store
Minnesota Lake, Bach Hardware
Morgan, Morgan Hardware
Nashwauk, Nashwauk Hardware
Osakis, Mouw Hardware
Procter, C. W. Austin
Redwood Falls, Paffrath-Voelz Hardware
Rushford, Jaastad Hardware
Saint Joseph, Loso Hardware
Saint Paul, Hamline Hardware
Two Harbors, Erickson & MacDonald
Vergas, Vergas Hardware
Waterville, Jacobson Hardware
Watkins, J. M. Ertl & Sons, Inc.
West Concord, Renner Hardware
Winona, Bambenek Hardware
Winthrop, L. J. Larson Co. Inc.

MONTANA

Missoula, Wright Lumber Co.

NEW HAMPSHIRE

Concord, C. E. Wilber Co.
Hanover, Hanover Hardware
Manchester, Clark's Hardware
Meredith, Prescott Lumber Co.
Pittsfield, H. P. Maxfield, Inc.
Raymond, Holt's Hardware
Salem Depot, Salem Hdwe. & Paint

NEW JERSEY

Asbury Park, Samuel Rubman
Belleville, The Glass Co.
Bergenfield, Bergen County Paint
Chartex Paint
Bloomfield, Taton Hardware
Bloomingdale, Thomas Hoff Hardware
Bogensburg, Chambers Coal & Lumber
Caldwell, H. E. Schland Co.
Cedar Grove, Bohny Bros. Hardware
Clifton, Fox Hardware
Friedman's Hardware
Lumberama
Dover, Sacks Paint & Wallpaper
East Paterson, Thomas Marino Hardware
Englewood, Englewood Paint & Hardware
Hudson Hardware
N. Simon Company
Fairlawn, Lincoln Hardware
Plaza Hardware
Florham, Florham Park Hardware
Freehold, J. A. McIlvaine
Frenchtown, George W. Eddy
Garwood, Garwood Paint & Hdwe.
Glassboro, J. T. Abbott & Son Inc.
Hackensack, B & S Company
McManus Floor Machine
Romaine Hardware Co.
Hackettstown, Hackettstown Hardware
Haledon, Haledon-Belmont Hardware
Haskell, Wanaque Supply Co.
Hawthorne, C. L. Siney Co.
Hillside, Kizyma Paint & Hardware
Jersey City, Miller's Hardware
Kearny, Ratta Hardware
Kenvil, Walt's Hardware
Keyport, Midtown Hardware
Lakewood, Lakewood Lumber Co.
Linden, Koenig Hardware
Livingston, Hardware Center
Lodi, Central Hardware
Madison, Otten & Jagels Hardware
Maplewood, Pietz Bros.
Maywood, Maywood Hardware
Metuchen, Metuchen Builders Supply
Montclair, South End Paint & Hardware
Morristown, Community Lumber Co.

5

Cummins PORTABLE TOOLS CKD

Daher's Hardware
Morristown Hardware
Netcong, Netcong Hardware
Newark, S. La Capra Hardware
New Milford, Housetown Hardware
North Bergen, Fred's Hardware
North Haledon, Ralph Falkena
Nutley, J. Rose, Inc.
Oakhurst, Kays Housewares
Oak Ridge, Boote Supply
Paramus, David Plumbing
Park Ridge, Quackenbush Lumber Co.
Passaic, Steber Hardware
Paterson, Angelica Hardware
Tirozzi Hardware
Treeman's Hardware
United Hardware
Pequannock, Van Ness Lumber Co.
Pompton Lakes, Smiley's Hardware
Pompton Plains, Jones Hardware
Ramsey, Ramsey Hardware
Riverdale, Pompton Feed & Supply
River Edge, Palmer Brothers
Roseland, Roseland Hardware
Sayreville, Sayreville Hdwe.
Sparta, Mac's Hardware
Spotswood, Spotswood Hardware
Union, Jaeger Lumber Co.
Villas, Villas Lumber Co.
Vineland, Joffa Hardware Co.
Wallington, 3 Sons Hardware
Wayne, Circle Building Supply
Mountain View Hardware
Westfield, Taylor Hardware
Tudor Hardware Co. Inc.
West Milford, West Milford Hardware
Westwood, E. J. Decker
Wood-Ridge, Star Stores

NEW YORK

Albany, Rosano Farm Store
Bronx, A & R Sales
Brown's Hardware
Fordham Supply Co.
Parkway Hdwe. & Paint Co.
Van Ness Hdwe.
Brooklyn, Bay Ridge Saw and Tool
M. S. Berkoff
Brother's Hardware
Gelfand Hardware
Krauser Hardware
R. J. Krieger
Park Slope Hardware
Paul's Hardware
Petersen Brothers
Square Deal Paint
Buchanan, Cole Bros.
Cornwall, Clouser Sales
Ushman Brothers
Dobbs Ferry, B. Adler Hardware
Elmsford, Elm Hardware Co.
Florida, Kujawski Bros. Hardware
Garnerville, Zugibe Hardware
Hastings On Hudson, Main Hardware
Haverstraw, Shaw Jobson
O. N. Rosenberg
Hicksville, Botto Brothers Hdwe.
Hudson, Hudson Lumber Co.
Hyde Park, Van Nosdall Hdwe.
Jamaica, F. Boenig & Son
Jeffersonville, W. W. Mall
Larchmont, Foley Hardware
Liberty, Sabloff's
Mahopac, Mahopac Supply
Massopequa Park, S & P Hardware
Middletown, Lloyd's
Monroe, Smith & Streble

Cummins PORTABLE TOOLS CKD FACTORY TRAINED DEALER

These Leading Dealers Will Show You the Way to

"PAY-OFF POWER"

New City, Lester Corelitz
New Rochelle, Spitzer Supply
New York, M. Blaustein & Sons
Booky Hardware
G & E Hardware
Garber Hardware
Goldsmith Bros.
Grand Central Hardware
Frank Hoffman
Kraus Hardware
Lohmann Hardware
Lucerne Hdwe.
New Hippodrome Hdwe.
Quality Hardware
S & S Hardware
Safeway Maintenance
Sol's Key Shop
Suburban Supply Co.
Wadsworth Hdwe.
Northport, Northport Hardware
North Tarrytown, C. Margotta Co.
Ozone Park, Shop-Rite Hardware
Patchogue, Grover Lumber Co.
Port Chester, Feinsod Hdwe.
Poughkeepsie, Malones Hardware
Red Hook, C. J. Stockenberg
Rhinebeck, Cookingham Hardware
Rye, Odell's Hardware
Shrub Oak, Lakeland Lumber
Sloatsburg, Sloatsburg Hardware
So. Ozone Park, Sonny's Hdwe.
Spring Valley, K & A Hardware

STATEN ISLAND, N. Y.

H. S. Farrell
Geisinger Hardware
Gelgisser Hardware
Mal's Hardware
Stoney Point, Homestead Hardware
Suffern, Home Appliance Service
Thornwood, Klingler Hardware
Tuckahoe, Cornell's
Wappingers Falls, Urey Hardware
Warwick, Miller & Stocken Lumber Co.
Watervliet, De Lollo Hardware
West Nyack, West Nyack Country Store
White Plains, House Center Hardware
Pickard Hardware
Woodridge, Sunray Paint & Hardware
Wurtsboro, Graubard Market
Yonkers, Grassy Sprain Hardware
Musci Hardware
J. C. Ryan
F. Schall
Service Center
Town & Country Lumber
Wm. Wrockledge

LONG ISLAND, NEW YORK

Baldwin, Josh Wolin's Hardware
Carle Place, Carle Place Hardware
Deer Park, A & J Hardware
East Meadow, Ace Store of East Meadow
Allan Lumber
Elmont, Tudor Hardware
Forest Hills, Yellowstone Hardware
Hicksville, Newbridge Lumber
Huntington, Central Hardware
Huntington Station, He-Lo Supply Inc.
New Hyde Park, Barlow Hardware
Oceanside, Oceanside Hardware
Port Washington, Manorhaven Hardware
Seaford, 3 Generations Hdwe.
Uniondale, Irwin Lumber Co.
Valley Stream, Wood's Hardware
Westbury, Ellisons Hdwe.
Mac Neil Hardware
West Islip, Higbie Garden Center
Wolliston Park, A & T Hardware Co.
Woodmere, B & B Hardware

NORTH CAROLINA

Clinton, Varina Builders Supply
Farmville, Varina Builders Supply
Greensboro, Varina Builders Supply
Raleigh, Varina Builders Supply
Rockingham, Varina Builders Supply
Timmonsville, Varina Builders Supply
Varina, Varina Builders Supply

NORTH DAKOTA

Bowman, Stubers Farm & Ranch
Jamestown, Hall Hardware
Lisbon, Bohlken Hdwe. & Furniture
Wahpeton, Bohlken Hardware & Furniture

OREGON

Beaverton, Falk's Hardware
Coos Bay, W. J. Conrad Lumber Co.
Cresswell, Cresswell Electric
Dallas, Western Auto Supply
Eugene, Hirshey Appliance Plants Inc.
Gladstone, Clackamas County Grange Supply
Myrtle Point, Moon Hardware
North Bend, Cooshead Builders
Oregon City, Friedrich's Hardware
Pendleton, Zimmerman Hardware
Pilot Rock, Pilot Rock Hardware
Portland, Beaumont Hardware
Burdick's Hardware
Francis Bros. Bldg. Mart
Hal's Bldg. Supply
La Forge's Hardware
Meier & Frank Dept. Store
Power Tool Center
Wink's Hardware
Salem, Busicks Lancaster Market
Meier & Frank Dept. Store
Valley Farm Hardware
Stayton, Western Auto Supply
The Dalles, Boyds Surplus
Tillamook, Buel Hardware

PENNSYLVANIA

Ambler, G. M. Deck & Co.
Athol, Zachs Sales
Bethlehem, Fink Supply Co.
Camp Hill, Moore's Builders Supply
Chester, Stress Bros.
Easton, Suburban Hardware
Feasterville, Feasterville Hardware
Fernwood, Master Hardware Co.
Gettysburg, George M. Zerfing
Harrisburg, Albright's Hardware
Kennett Square, Square Hardware Co.
Lancaster, Farmers Supply Co.
New Holland, Groff's Hardware
Norristown, Eskin Hardware Co.
Philadelphia, Frankford Hardware Co.
Hidell Hardware
Penn Hardware Co.
Frank Yaskin's Sons
Pottstown, Van Buskirk & Bro.
Reading, J. W. Leinbach Hardware Co.
Willow Grove, Eskin Hardware Co.

SOUTH CAROLINA

Orangeburg, Varina Builders Supply

SOUTH DAKOTA

Deadwood, Stearns & Shedd
Dell Rapids, Krans Hardware
Pierre, Spargur Hardware
Rapid City, Pavek's West Side Hardware

TEXAS

Arlington, Bowman-Cass Lumber Co.
Bedford, Walter Fitch Hardware Co.
Blooming Grove, W. E. Carrol Hdwe.
Bridgeport, Jones Hardware Co.
Chico, Brooks Motor & Hardware
Cleburne, John Street Hardware Co.
Crosbyton, Brashear's
Dallas, Barn's Lumber Co.
Glendale Hardware Co.
Kessel's Hardware Co.
Walnut Hill Hardware Co.
Wiseman Hardware
Denton, B & H Lumber Co.
David Mulkey Hardware Co.
Denver City, Stanley Auto Supply
Ennis, Ross Crumley Hardware
Fort Worth, Buddies Feed & Farm Store
Everybody's
Forest Hill Hardware Co.
O. B. Guynn Hardware
Massie Supply Co.
Ridglea Hardware Co.
Schmid Hardware
Grand Prairie, Grand Prairie Hardware Co.
Hamilton, Wilson Hardware & Electric Service
Hurst, S & S Hardware Co.
Idalou, Blue Flame Gas Co.
Itasca, McPherson Hardware
Justin, Justin Lumber Co.
Killeen, Killeen Hardware Co.
Knox City, City Hardware Co.
Littlefield, Nelson Hardware Co.
Mansfield, Wynn's Hardware Co.
Meridian, Meridian Hardware Co.
Mexia, Tyner-Lokey
Morton, Higginbotham-Bartlett Lumber Co.
Muenster, Community Lumber Company
Plainview, Plainview Hardware Co.
San Antonio, Joskes
Scurry, Cates Lumber Company
Temple, Temple Hardware Co.
Terrell, Crain's Home & Auto Supply
The Grove, The Grove Lumber Co.
Weatherford, Glen Sanders Hardware & Auto Supply

VIRGINIA

Newport News, Moore's Builders Supply
Norfolk, Moore's Builders Supply
Petersburg, Moore's Builders Supply
Richmond, Moore's Builders Supply
South Norfolk, Moore's Builders Supply
Verona, Moore's Builders Supply

WASHINGTON

Aberdeen, Lumber Supplies Inc.
Centralia, Graystone of Centralia
Midway Building Supply
Chehalis, Lewis Pacific Dairyman's Association
Connell, Connell Builders Supply
Kelso, Baker Lumber Co.
Longview, Schneider's Hardware
Moses Lake, Express Lumber Co.
Newport, Diamond Gardner Corp.
Geaudreau Lumber Co.
Opportunity, Madison Lumber & Mill Co.
Othello, Broadway Lumber & Mill
Pullman, Standard Lumber Co.
Raymond, Dennis Co.

Spokane, Country Homes Supply
Diamond Gardner Corp.
Hoesly's Hardware
Kehoe Hardware
Lincoln Heights Bldg. Supply
Marshall's Northtown Hdwe.
North Hill Hardware
Northwest Hardware
Stewart's Home Town Hdwe.
Trentwood, Leader Lumber & Hardware
Warden, Geaudreau Lumber Co.

WISCONSIN

Appleton, Do It Yourself Shops
W. T. Grant Co.
Belleville, Koltes & Keegan
Eau Claire, Consumers Coop Association
Ellsworth, Hovde Hardware
Green Bay, Van's Supply & Equipment Co.
Lodi, Koltes Lumber Co.
Madison, Findorff Lumber Co.
Koltes & Esser Hdwe.
Mazomanie, Koltes Hardware
Menomonee Falls, Neu Supply Line
Middleton, Fish Building Supply
Koltes & Keegan
Milwaukee, American Plumbing Stores
W. T. Grant Co. (Southgate)
Schuster's
Steinman Lumber Co.
Weissman Hardware
Prairie du Sac, Koltes & Kennedy
Racine, Norm's Builders Hdwe.
Saint Croix Falls, Clayton Hardware
South Milwaukee, Modern Bilt Lumber Co.
Stoughton, Koltes & Keegan Stores
Sun Prairie, Koltes & Moldrem
Superior, East Side Hardware
Waunakee, Koltes Lumber Co.

CANADA

ALBERTA

Alliance, McLennan Hardware
Athabasca, A. O. Evans
Bowness, Bowness Hardware
Calgary, G. L. Chesney Hardware
Findlay Hardware
Muttart Bldg. Supplies
Nagler's Limited
Orville Burke Lumber
Ribtor Surplus Sales
Carstairs, Trottier Brothers
Didsbury, Leeson Hardware
Eckville, Eckville Co-op
Edmonton, Imperial Lumber Co.
Jamieson Hardware
J. C. McLeod Building Supplies
M. D. Muttart Limited
Northern Hardware Co. Ltd.
Woodwards Stores Ltd.
Innisfail, Burrows Hardware
Lethbridge, North Lethbridge Hardware
Medicine Hat, Sept & Sons
Red Deer, Mitten & Sherbino
Rocky Mountain House, Killico Stores
Spruce Grove, McLeod Mercantile Co.
Vegreville, Northern Hardware Co. Ltd.
Vermilion, Northern Hardware Co. Ltd.

BRITISH COLUMBIA

Campbell River, Central Builders Supplies
Chilliwack, P & E Builders Supplies Ltd.
Coquitlam, Van's Building Supplies Ltd.
Duncan, Garner Builders Supplies Ltd.
Esquimalt, Stelck's Esquimalt Hdwe.
Haney, Fuller-Watson Ltd.
Kamloops, N. S. Dalgleish Ltd.
Kelowna, Wm. Haug & Son Ltd.
Kitimat, Kitimat Builders Supplies
Nanaimo, Stewart & Hudson Ltd.
New Westminster, Ridgeway Hdwe. & Bldg. Supplies
Sarginson & Dumond Ltd.
Woodward Dept. Stores Ltd.
Port Alberni, A. McDonald & Sons
Prince Rupert, Philpott-Evitt Co. Ltd.
Richmond, Lansdowne Hardware
Trail, D. B. Merry Lumber Co.
Vancouver, B & B Hardware Ltd.
Collingwood Hardware Co.
Cristalls Ltd.
Harvey's Stores Ltd.
Woodward Dept. Store Ltd.
Vernon, Wilcox-Hall Co. Ltd.
Victoria, Shawnigan Lumber Yards Ltd.
Stelck's Hillside Hdwe.
Stewart and Hudson Ltd.
West Vancouver, Hodgson Clarke Stores Ltd.
West Vancouver Hdwe. & Home Appl.
Woodward Stores
Whalley, Arrow Building Supplies
Whitehorse, Northern Commercial Co. Ltd.

ONTARIO

Almonte, N. S. Lee & Sons
Aylmer, Monteith Hardware
Belleville, E. D. Mott & Sons Limited
Arthur A. Sills & Son Ltd.
Wills Hardware
Blind River, F. Y. W. Braithwaite
Bowmanville, McGregor Hardware Ltd.
Bradford, Gardner Hardware
Brantford, Elliott-Wedlake Ltd.
Brockville, Stewart Hardware
Burford, Balsdon Hardware
Burlington, Dales Hardware
Lindley Bros. Ltd.
Chatham, Douglas Hardware
Richmond Hardware
Clinton, Ball & Mutch I.H.A. Hardware
Cobourg, Roy Caine Lumber Co.
Cornwall, Snetsinger I.H.A. Hardware
Delhi, Smith Hardware & Heating
Don Mills, Jack Bailey Hardware
Elliott Lake, Super Shops I.H.A. Hardware Ltd.
Frankford, Frankford Hardware
Forest, Lochead Hardware
Gananogue, Donevan Hardware
Hamilton, Wentworth Lumber Ltd.
Highland Creek, Lomas Hardware
Islington, Len Barraca Building Supplies
Lakeview, Briscoe Hardware
Listowel, Hay I.H.A. Hdwe.
Lorne Park, Bolton-Ellis-Weaver
Merritton, McNeil I.H.A. Hardware
Milton, Milton Hardware
Norwich, Maybee I.H.A. Hardware
Oshawa, Swan Hardware
O'Sullivan, Matthews Hardware Ltd.
Ottawa, Desjardin's I.H.A. Hardware
Morris I.H.A. Hardware
Vandervoort I.H.A. Hardware
Pembroke, Philips Hardware
Penetanguishere, McDonald Hardware
Perth, Chaplin & Code
Port Credit, Ryerson Hardware
Port Perry, Peel Hardware
Renfrew, McPhail Hardware
Richmond Hill, Richmond Hardware
Rockwood, Root Hardware

6

Cummins
PORTABLE TOOLS
CKD

Saint Catherines, McNeil Hardware
Saint George, Longs Hardware
Sault Ste. Marie, Hill Hardware
Simcoe, Prelipp-Schott Hardware
Smith's Falls, Clark & Lewis
Tilbury, T. F. Van Aman & Sons
Tillsonburg, Mabee I.H.A. Hardware
Toronto, Glen Agar Hardware
Austin Hardware & Sports
Jack Bailey Hardware
Gil Crossen Hardware
N. Davis Hardware
Hudson Hardware
Kennedy Park Hardware
Potter Hardware
W. L. Rice & Sons Ltd.
G. Travis I.H.A. Hardware
Jack Watts Hdwe. Ltd.
York Mills Hardware
Trenton, The Allore Company Ltd.
Bailey Hardware
Weston, Bannerman Hardware
Riggs Rexdale Hdwe.
Windsor, Bird Hardware
Wingham, Stainton Hardware
Woodstock, Dennis Hardware

QUEBEC

Boucherville, Marcel Turcotte
Buckingham, Societe Coop. de Buckingham
Croydon, John Ryan Ltd.
East Broughton, Laiterie Cooperative Agricole
Gatineau, Jean Racine
Grand-Mere, Ferronnerie Grand-Mere Enrg.
Hull, Lafrance Auto Parts
Stade Enrg.
Lac Megantic, Prosper Bouchard
Laval Fortier
Magog, Ferronnerie Robert & Frere
Mistassini, Jos. Sasseville
Montreal, Bernard Hdwe.
Ernest Mongeau Enrg.
Ferr. Hochelaga
Fredette & Frere
Gagne Hardware
J. E. Hubert Enrg.
Mousette Ltee.
Notre Dame Hardware Co.
G. Poirier
V. St-Onge Ltee.
Pierreville, Shooner & Cie
Rigaud, Rigaud Lumber Supply
Shawinigan Falls, Alfred Belanger
Ste-Genevieve-De-Pierrefords, Andre Theoret
Ste-Therese-De-Blainville, Alec. Desjardins
St-Antoine-Des Laurentides, Ferronnerie St-Antoine
St-Bruno, Ferr. St-Bruno Enrg.
St-Chrysostome, Blais & Freres
St-Felicien, Ferronnerie St-Felicien
St-Joseph-De-Beauce, Cooperative Agricole
St-Paul, Ile-Aux-Noix, R. Fleury
Tring Jonction, L'invincible Syndicat Coop.
Trois-Rivieres, Ferronnerie Laviolette Enrg.
Ville Jacques-Cartier, Andre Roberge
Ville Lasalle, L. Daoust Limitee
Jacob Hardware Reg'd.

SASKATCHEWAN

Lloydminster, Nelson Lumber Co.

Handy Cummins Blade Reference Chart

select the right blade for the job!

COMBINATION BLADE
Most popular for general purpose wood cutting. Rips or crosscuts with ease.

CROSSCUT BLADE
Designed for cutting across the grain of wood.

RIP BLADE
For rough cutting lengthwise with grain of wood.

FLOORING BLADE
Holds its edge longer where nails, dirt and grit are encountered.

MITER (Planer) BLADE
Hollow ground to leave extremely smooth cut without tearing.

FINE TOOTH BLADE
Use for cutting soft materials such as fiber board, plywood, wallboard, up to ¼" thick.

FRICTION BLADE
Designed for cutting light gauge sheet steel up to 16 gauge.

METAL CUTTING BLADE
Ideally suited for cutting non-ferrous metals.

DADO CUTTER
(Grooving Blade) Use for ploughing (grooving with grain) and dadoing (grooving across grain).

CUTOFF WHEEL
(Abrasive) Abrasive, for scoring and cutting concrete, brick and other similar porous materials.

REINFORCED CUTOFF "NORFLEX" WHEEL
Reinforced abrasive wheel for added cutting strength and life. Requires Hub Set.

A CLEAN SHARP BLADE PROLONGS THE LIFE OF YOUR MAXAW AND WILL PRODUCE BETTER CUTTING RESULTS.

SELECTING THE PROPER BLADE FOR THE JOB (Refer to Catalog or Price List for Blade Number)

MATERIAL TO BE CUT	BLADES AND WHEELS										
	Combination	Cross-cut	Rip	Planer (Miter)	Fine Tooth	Flooring	Friction	Metal Cutting	Dado Cutter	Cutoff Abrasive	Cutoff Norflex
Hardwood — Normal or Smooth Cut	✓			✓							
Soft Wood — Normal or Smooth Cut	✓	✓	✓	✓							
Plywood — Normal or Smooth Cut	✓	✓		✓	✓						
Old Flooring and Used Lumber		✓				✓					
Celetex, Gypsum Board, Insulite, Plaster Board, and Similar Porous Materials		✓			✓						
Hard Wallboard, Masonite, Pressed Wood		✓									
Concrete, Cement, Sewer Tile, Limestone										✓	✓
Marble, Hard Tile, Ceramic Clay										✓	✓
Asbestos, Cement Sheets, Transite, Insel Wood										✓	✓
Flue Tile, Brick, Terrazzo, Terra Cotta										✓	✓
Tuck Pointing and Scoring Concrete										✓	✓
Slate and Sandstone										✓	✓
Corrugated Galvanized Sheets, Sheet Steel up to 16 Gauge							✓				
Non-Ferrous Metals — Brass, Bronze, Copper, Aluminum, Lead, Soft Copper, Magnesium								✓		✓	✓
Ploughing — Grooving with Grain Dadoing — Grooving Across Grain									✓ ✓		
"Formica," "Micarta," "Consoweld," etc.								✓			
Metal and Wood Laminations								✓			

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Tear Out for Handy Reference!
To remove this booklet, place your left hand on the facing magazine page, grasp booklet with your right and gently pull it away. Keep it for future reference!

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Division of John Oster Mfg. Co.
Milwaukee 17, Wisconsin

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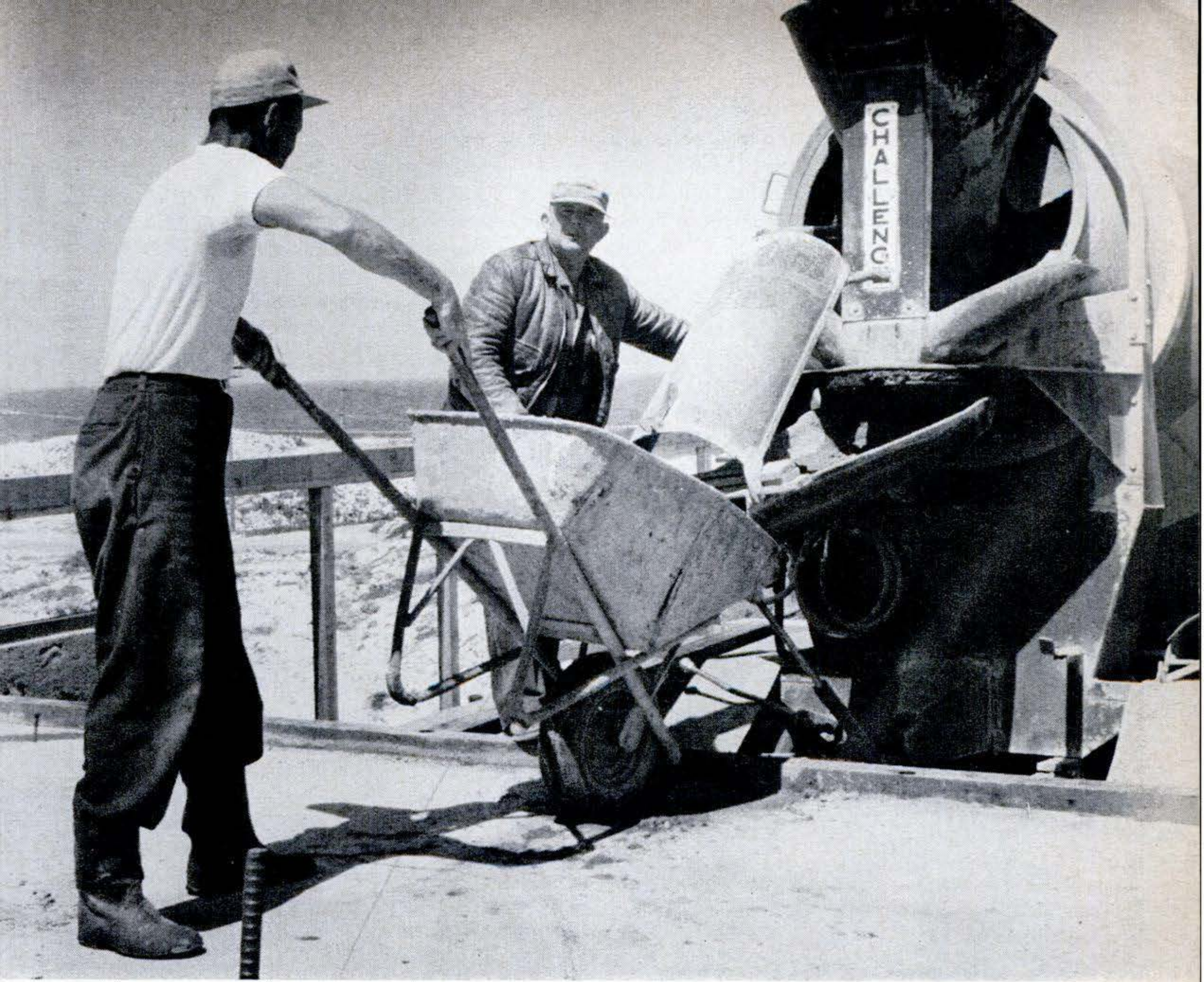

Getting Ready for Ready-Mix

Do you always think of transit-mixed concrete as something for contractors only? Not so. It's for every one of us

By Darrell Huff

TRANSIT-MIXED concrete, as a lot of people are finding out, can save time and backache on all but the smallest and most inaccessible jobs. It can cut the labor in half and cost little or nothing more than a mix-it-yourself cement job.

You can quickly make a local check on that last statement. Get a price on sand-and-gravel, delivered, per yard. Add 50 percent. (It takes 1 1/3 yards of the stuff, oddly enough, to make a yard of concrete, and there's a good bit of waste when it has to be dumped on the ground.) Add the cost of five sacks of cement, delivered. Then compare . . .

For my West Coast neck of the woods it comes to about $17.50 if you mix your own, $21 if you buy ready-mix. That's in one-yard lots.

CONTINUED

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But suppose I plan my work to handle three yards at a crack—not an excessive amount when you realize that with one helper, female, by my side I've been known to make away with five times that much in a day. The price drops to $14 a yard for ready-mix—and $14.70 if I mix my own.

As the result of such simple arithmetic, the home-style concrete mixer passed quietly out of my life. And I began to learn that there are techniques to using transit-mixed mud just as there are to home mixing. There are 10 points.

POINT 1. Get the soil ready ahead of time. There'll be no leisure for fooling around after the cement comes.

Level the area by shaving off the high spots and filling in the low, then tamping to compact the soil. If you have clay, hardpan, or poor drainage, fill with a few inches of cinders or gravel.

At the same time chop off any high spots close to where the forms are to go. You won't want hummocks in your way when the concrete is pouring in fast and you're running the usual two-by-four across to strike it off level.

POINT 2. Make the forms level and stout so they'll require no adjusting later. If they collapse right under the driver's professional eye your embarrassment will hurt worse than the loss of concrete.

Brace wall forms from the outside so they won't spread, and tie them together. If they show any inclination to collapse inward now, stick in short pieces of one-by-two as spacers. You can knock these out as the concrete goes in.

For slab or sidewalk, pound in or saw off all stakes level with the top of the form. Then they won't be in the way when you screed off the concrete.

If you plan to use the form material for forms again, brush it with old crankcase oil so concrete won't stick to it. If you're going to salvage the form lumber for a use where oil would be objectionable, shellac or varnish it instead.

POINT 3. If you're using reinforcing steel, cut and shape it ahead of time. Middle of a pour is no time to stop and work with hacksaw or cutters.

Place as much steel as possible in advance. Rods can often be supported inside the forms on long nails. Use stones or chunks of brick or concrete the right thickness to hold the mesh up to the height of the middle of the slab.

Or you can simply put the mesh in place on the ground, lift it to mid-slab during the pour. Remember that with ready-mix, which goes fast, you must do it as you go along. Later may be too late.

POINT 4. Preplan the truck route. Scheme the proceedings to bring the mixer truck as close to the forms as possible. The ideal is to dump directly from the truck without using a wheelbarrow at all, and trucks commonly have a chute capacity of about 10 feet. If chuting is to be downhill, distances can be longer. A sheet of corrugated aluminum or iron bends easily into trough shape as an auxiliary chute.

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For a large slab or driveway job, omit the formwork at one end so the truck can drive right in and deposit its mud as it moves out again. But have the missing bit of form prefabbed and ready so you can put it up quickly.

Watch out for weak spots where the multi-ton truck is to go. You may want to cover some of your driveway or lawn with two-by-twelves. Consult the transit-mix supplier if you see any problems on this. The company may send a man to look things over, and he may—as has happened to me—be able to lend you some timbers.

If the route problem is traction, as with soft sand or mud, the mix people will welcome warning about that, too. They may, as they did on the last job at my house, bring a stack of surplus aircraft landing mats to spread out.

POINT 5. Assemble tools before you start. You'll need at least a shovel and rake for spreading the concrete, a long two-by-four or two-by-six for striking it off, and a wood float for leveling.

Depending on the job and finish you want, you may need a steel trowel (or two) for finishing, an edger for corners, possibly a broom for texturing the surface. To divide a sidewalk or pattern a patio you may want a groover.

Consider also the virtue of having boots ready in case some of the spreading can best be done by wading right into the mess. Personally, I wear overshoes over bedroom slippers.

Gloves are good to have at hand, too, and so are spare pairs for use after the first ones get wet through.

You will almost certainly need a wheelbarrow. On a big job a contractor's deep model will beat the ordinary house-and-garden variety all hollow. But don't rush out to buy, or even rent, one. Ask first if your ready-mix man will lend you one free of charge, as mine does, hauling it along on his truck when he brings the mud. But ask ahead of time; this is one of those free services you can latch onto if you know about them and speak up.

POINT 6. Make a sturdy runway for that wheelbarrow. Use as broad a plank as you can get. Slope it as gently as possible. Ready-mix is a prime sweat-saver but it won't seem like it while you're hustling big barrow loads.

Make your barrow highway as smooth as you can. This is not so much to save jar on your tennis elbow as to keep the aggregate in the concrete from separating. You wouldn't think such heavy stuff could be delicate, but it is.

For the same reason, schedule your wheeling to dump the mud just where you need it. Excessive shoveling around will be almost as hard on the concrete as on you. Arrange things to place each load so it will slump into the previous one rather than away from it or on top of it.

Lay out the runway so you will pour the first concrete at the far end of the day's job. You don't want to have to go round, or wade through, the first load.

Also plan so that when pouring a wall or deep foundation you can lay the concrete in layers six inches to a foot thick, starting at the ends and working toward the middle.

POINT 7. Holler for help in advance. Most concrete jobs call for at least two people, one on each end of the screed board. Make the deal with your neighbor or hired helper so you can depend upon him to be there when the mud comes. Have enough help so that you won't in-

CONTINUED

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cur the extra charge made for stand-by time, which refers to too-slow unloading.

You will probably find that you can count on the ready-mix driver as your ace in the hole in those moments when you find yourself one pair of hands short. There may be some drivers who won't pitch in and labor by your side, but all four who served me in recent months did.

POINT 8. Estimate your needs generously and place your order early.

By ordering a couple of days ahead you can usually pick your time. First load of the day, around eight a.m., is often the best choice. An early start avoids a risk of troweling by moonlight, which is a heck of a way to spend an evening and may produce a rough slab.

To estimate quantity, just multiply the length and width in feet by the thickness in inches and divide by 12. This gives you cubic footage. You'll need a yard of concrete for each 27 cubic feet.

If anything about this, or the situation otherwise, throws you, consult the company. Ask also about figuring the job to get the best price. In my area, for instance, two yards bought separately cost as much as three taken at a crack, which works out to an appealing 33-percent discount on the bigger quantity.

If you are doing a lot of concreting—retaining walls, say, or a slab floor, or a long driveway—investigate these price brackets fully. Perhaps your company, like mine, will give the quantity price on small batches when part of a large order.

A final tip on estimating: Order plenty. Running even a shovelful short may be an infernal nuisance. (But a few stones kept handy to shove in can make up a tiny deficiency.)

POINT 9. Prepare extra forms in which you can use up any excess concrete.

Most yards need a variety of small concrete items—splashboards, garbage-can bases, bits of sidewalk. Have forms ready for these or for future big jobs on which you can now pour a bottom layer.

One simple solution is to build a few two-foot-square frames of two-by-two lumber. Filling these with any excess concrete will give you a useful supply of stepping stones or patio pavers. You may want to hose down the surface of the concrete as it begins to set (an hour or so after pouring). This will give the textured surface called exposed aggregate.

POINT 10. Wet the area thoroughly a couple of times on the day before you pour the concrete. Damp earth won't suck all the water out of concrete and lead to what cement workers commonly call a blankety-blank snap set.

This is an especial nuisance with ready-mix because of the quantity usually involved and the big hurry you are in. You need time to work the stuff into position and to finish it before it has taken on a shape of its own sweet choosing. Losing moisture into the ground also prevents slow curing—and strong concrete.

And that, after all, is what you're after: big results with a minimum of cost and backache. When you plan the job right, using transit-mixed concrete is a highly efficient way of getting just that.

Sketches courtesy of Permanente Cement Co.

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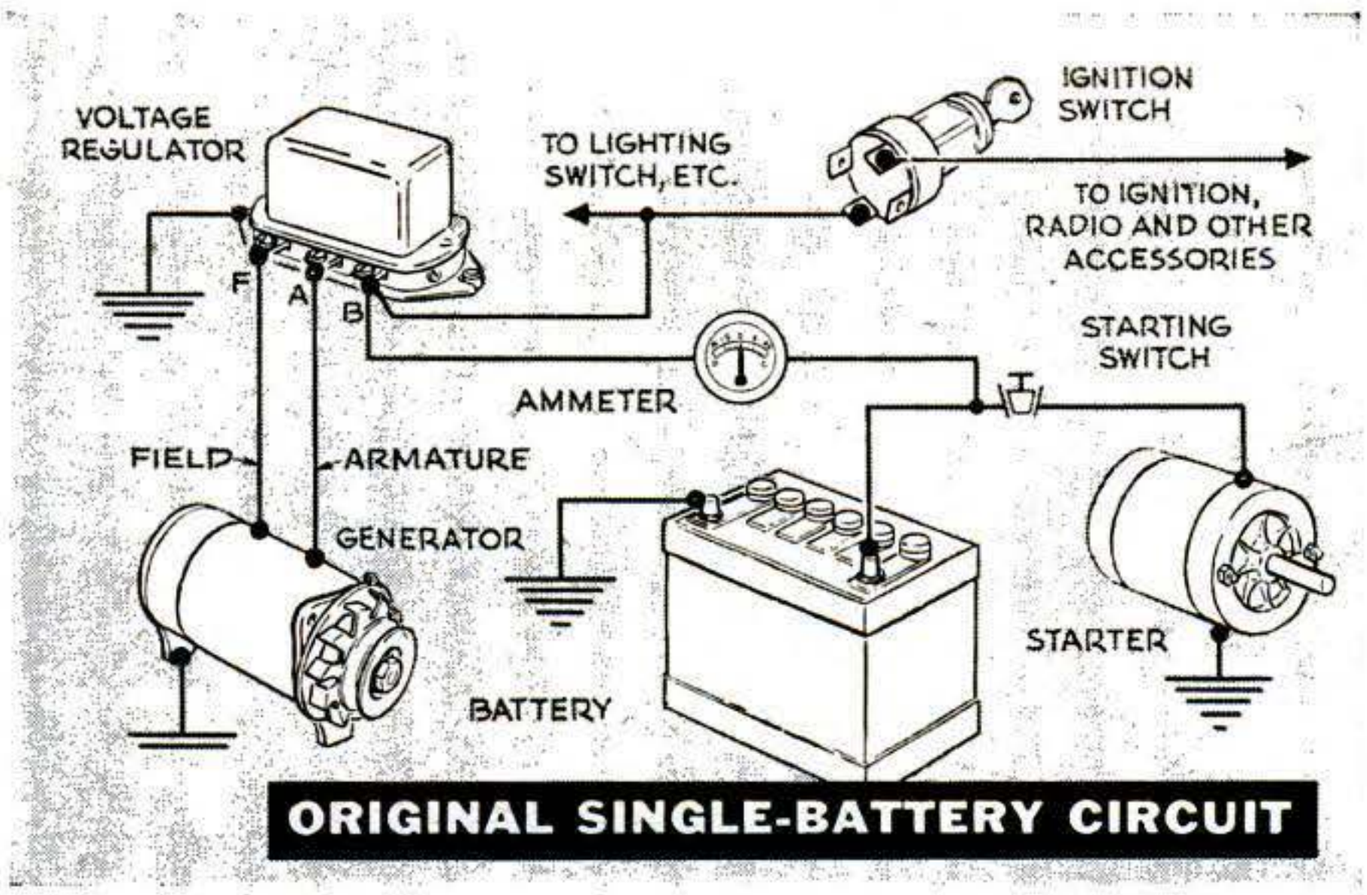
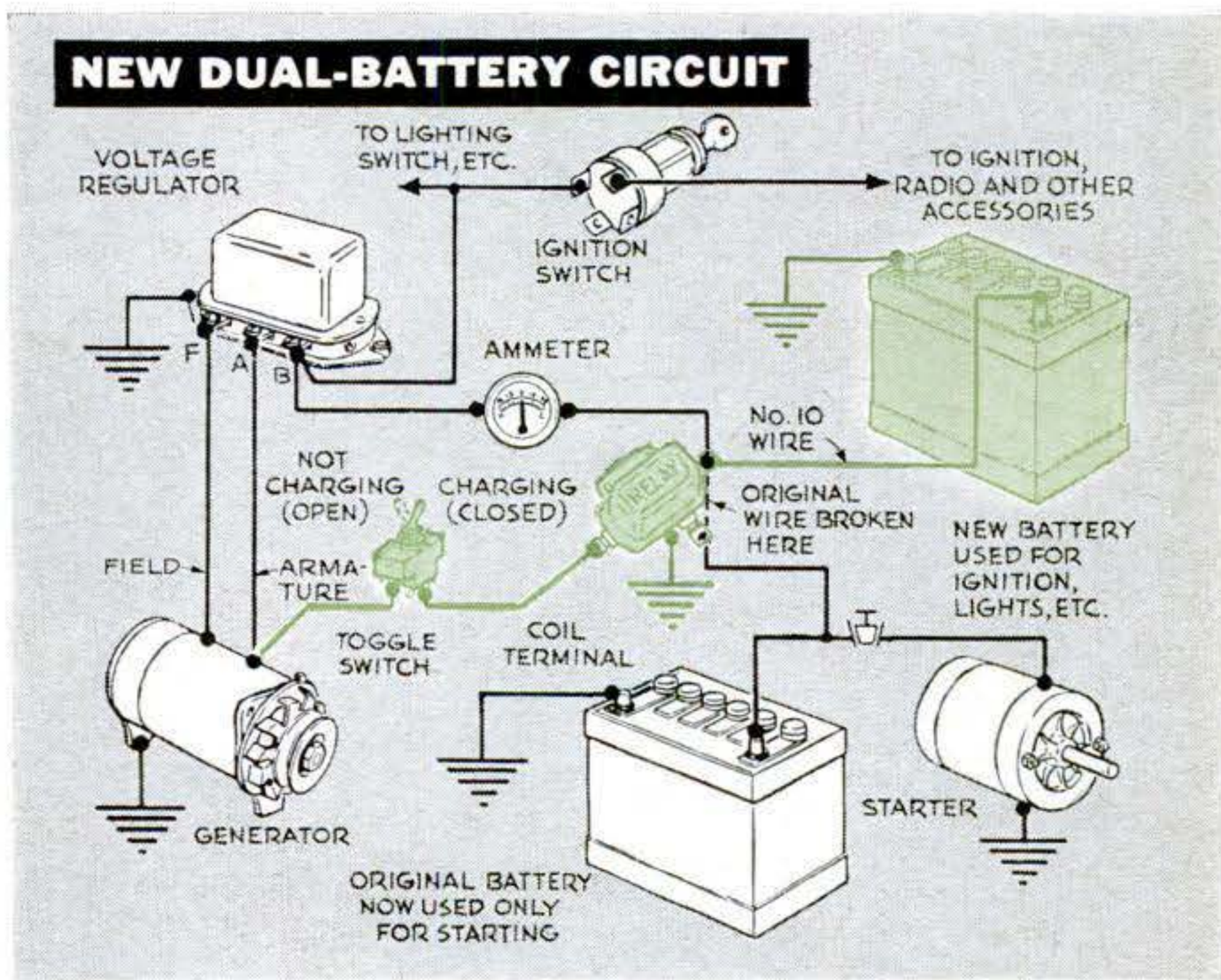
Spare Battery Saves Stranded Boats



ORIGINAL SINGLE-BATTERY CIRCUIT

ONLY ONE CHANGE IS NEEDED to convert a single-battery system to dual batteries. Original wire from the ammeter to the starting switch is cut and the ends are wired to switch contacts on the relay. To operate the relay, a wire is run from its coil terminal to the generator through a toggle switch that permits disconnecting the starting battery when the generator isn't charging. New parts you add are shown in color below. The relay (either six- or 12-volt to match the system) and other parts needed for the conversion are available at marine dealers.

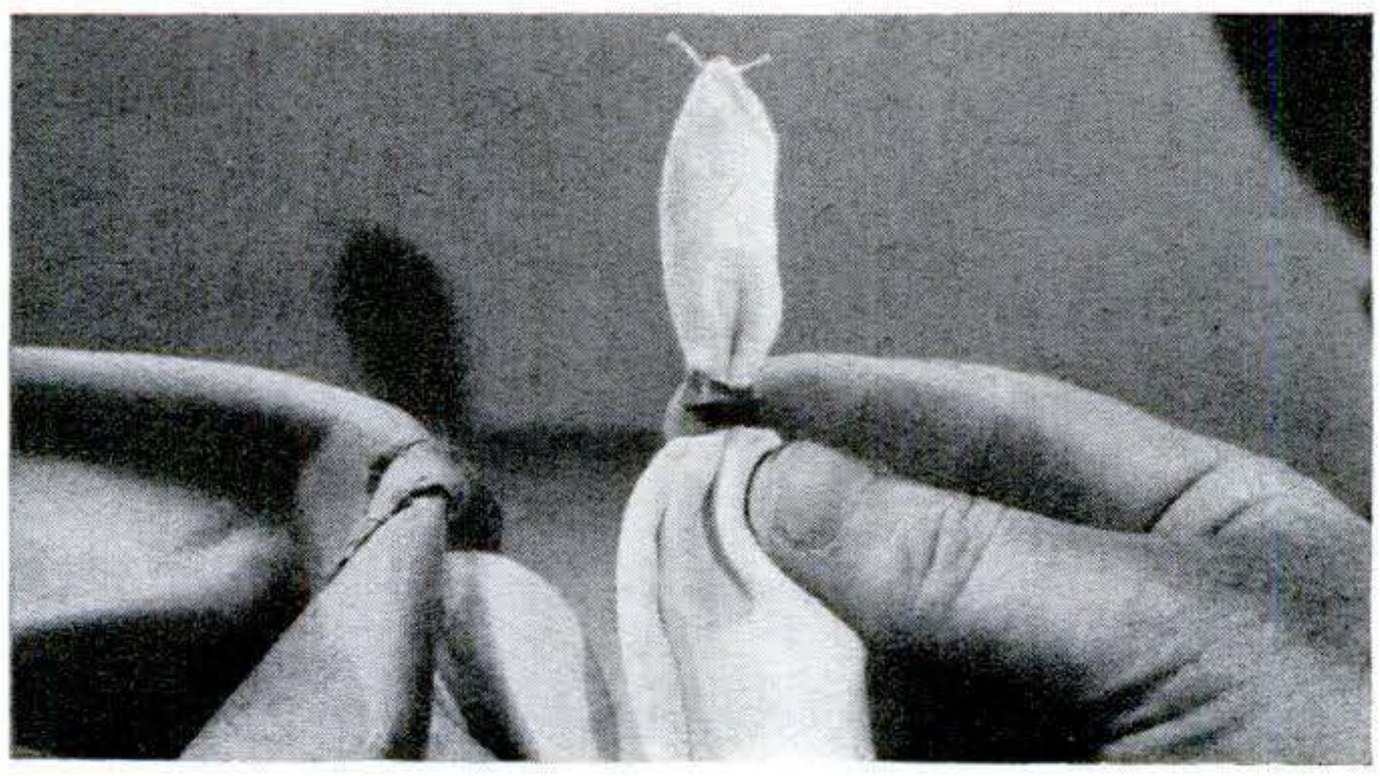


NEW DUAL-BATTERY CIRCUIT

INBOARD boats aren't likely to get caught out on the high seas with a dead battery if owners adopt this dual-battery system. One battery is used to run ignition, lights, horn, and other accessories, while a second standby battery is kept for starting power only. This way, you can always start your engine and get home safely even if the regular battery quits cold.

At normal boat speeds, both batteries are charged by the generator. At low speeds when the generator stops charging, you flip a switch that disconnects the starting battery so it can't discharge. This keeps it fully charged and ready for use. A relay also disconnects the battery when you stop the engine. Then if short circuits develop, or if lights or other accessories are left on, they can't run down the spare battery.

The dual system, devised by Exide, can be incorporated in any six- or 12-volt circuit by adding a battery, relay, and switch, as shown in the drawing.



Quick Fix for a Pocket

WHEN you discover a hole in your change pocket, you can close it in one second. The trick is to snap a rubber band tightly around the outside of the gathered cloth, just above the tear. It will hold until a neater and more permanent repair can be made.—*Kent Martin, Detroit.*

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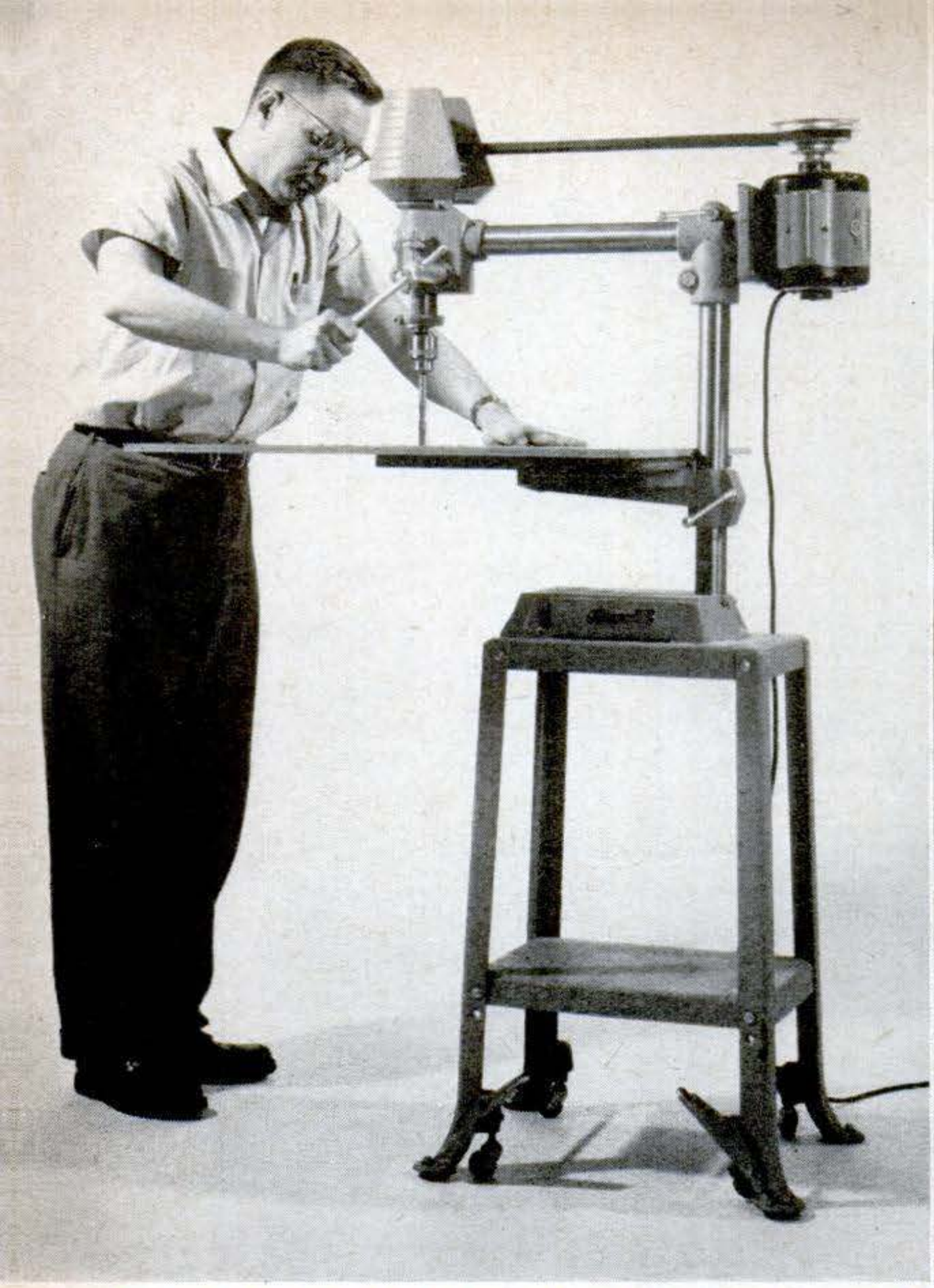
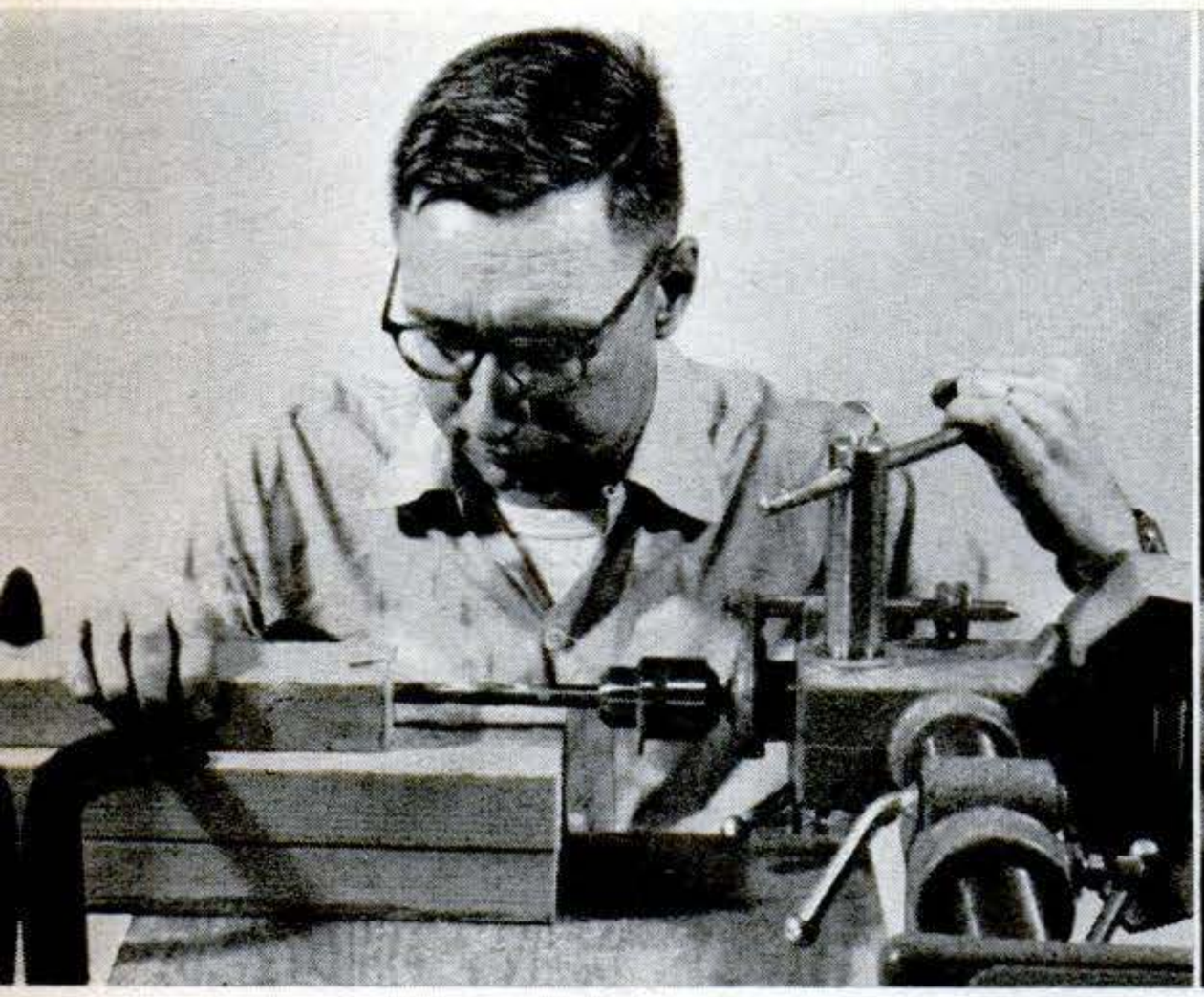


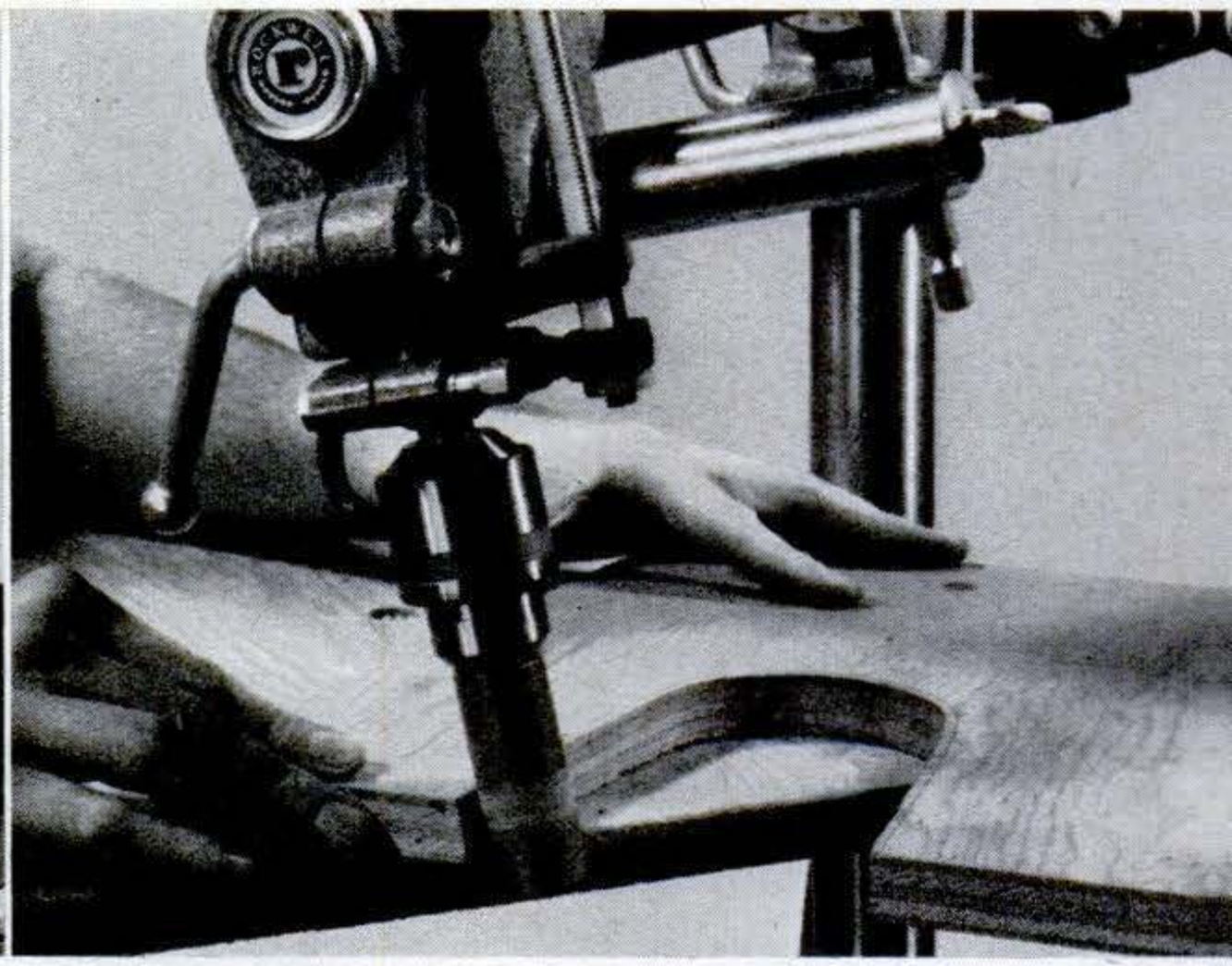
IT HAS A LONG REACH: With radial arm fully extended, the drill can reach the center of a 32″ panel. Arm swivels 360 degrees. Stand and retractable casters are extra-cost options.

HEAD TILTS for working at angles. It's fixed on the horizontal arm which revolves and slides in "T" atop vertical column. Tubular members are locked in place by double wedge clamps.

The tilting head and sliding arm make possible



HORIZONTAL DRILLING: Drilling the ends or edges of big pieces is easy. Turn drill to position, then block up work on table. Table can be raised to within 4½″ of drill axis.



DRUM SANDING comes naturally without additional jigs. The swinging arm positions drum beyond the table edge and below the work surface. Drum is new Delta carbide-grit type.

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SHOP-USE REPORT on the

New Delta Radial Drill Press

By Ernest E. Hickman

THE folks at Delta have been listening at the workshop door. They've now come up with a tool that is tailored to the workshopper's needs—a new radial drill.

Having worked—or played—with this machine, I suspect that the makers underestimate it in calling it a mere drill. Actually, it's a shopful of tools.

Basically, you see a revolving spindle at the end of a long, sliding arm. That spindle can be tilted and locked in any position. What you do with it depends on your imagination and what's fastened to the spindle. It will even do a bit of lathework—cutting round shanks on square table legs—with a plug cutter, and the drill in horizontal position.

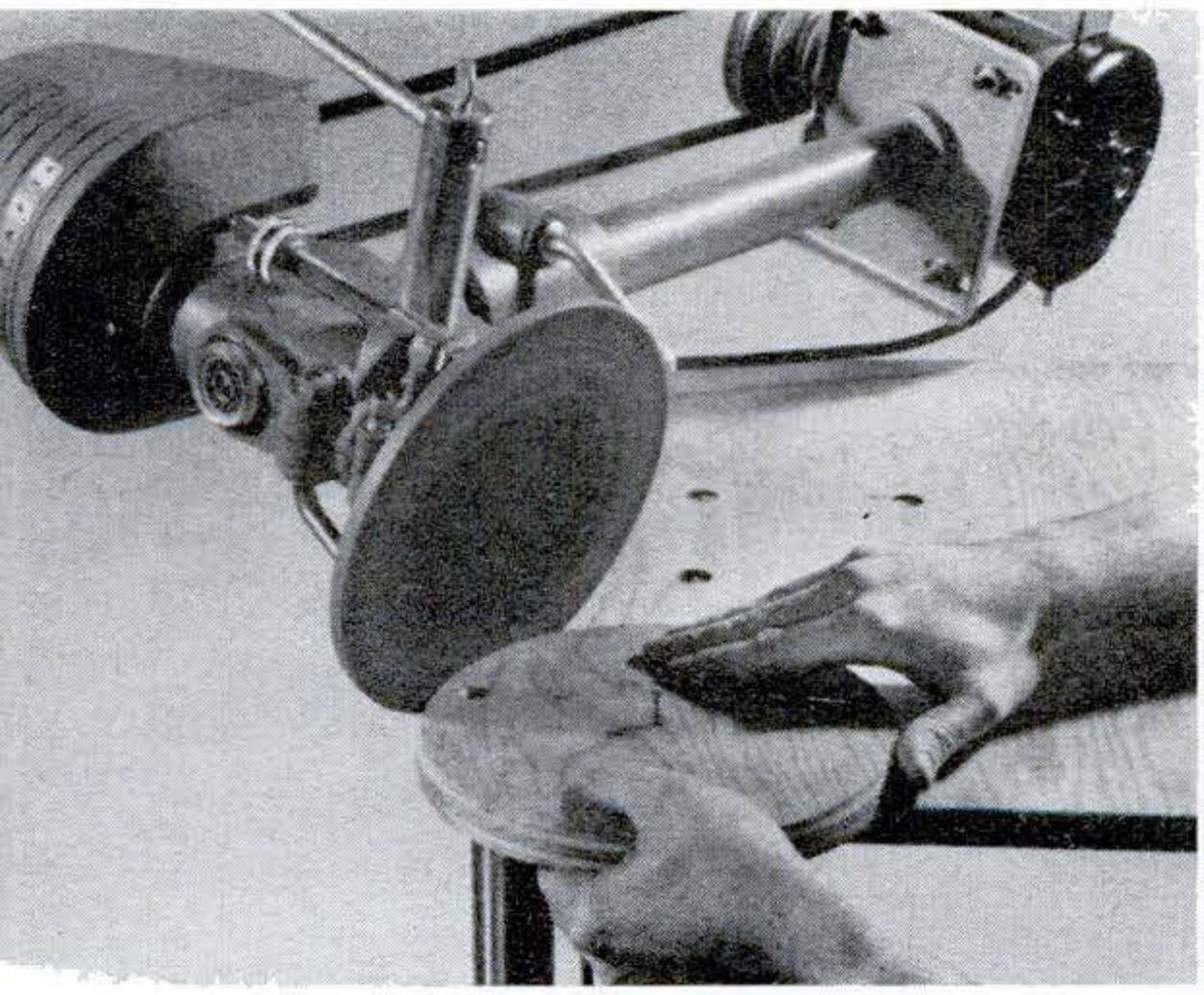
As a straightforward drill press, it's a giant. There's room for 16 inches of work between the drill and the upright column. In the strange way that drill presses are measured—by the diameter of the circle they can center-drill—this one qualifies as a 32″ drill press.

I wondered if the tilting head would spoil the 90-degree accuracy of the drill, but found out Delta got there first. The radial arm—which revolves to tilt the head—has a positive 90-degree index. It's a spring-loaded key that slides in a groove milled along one side of the arm.

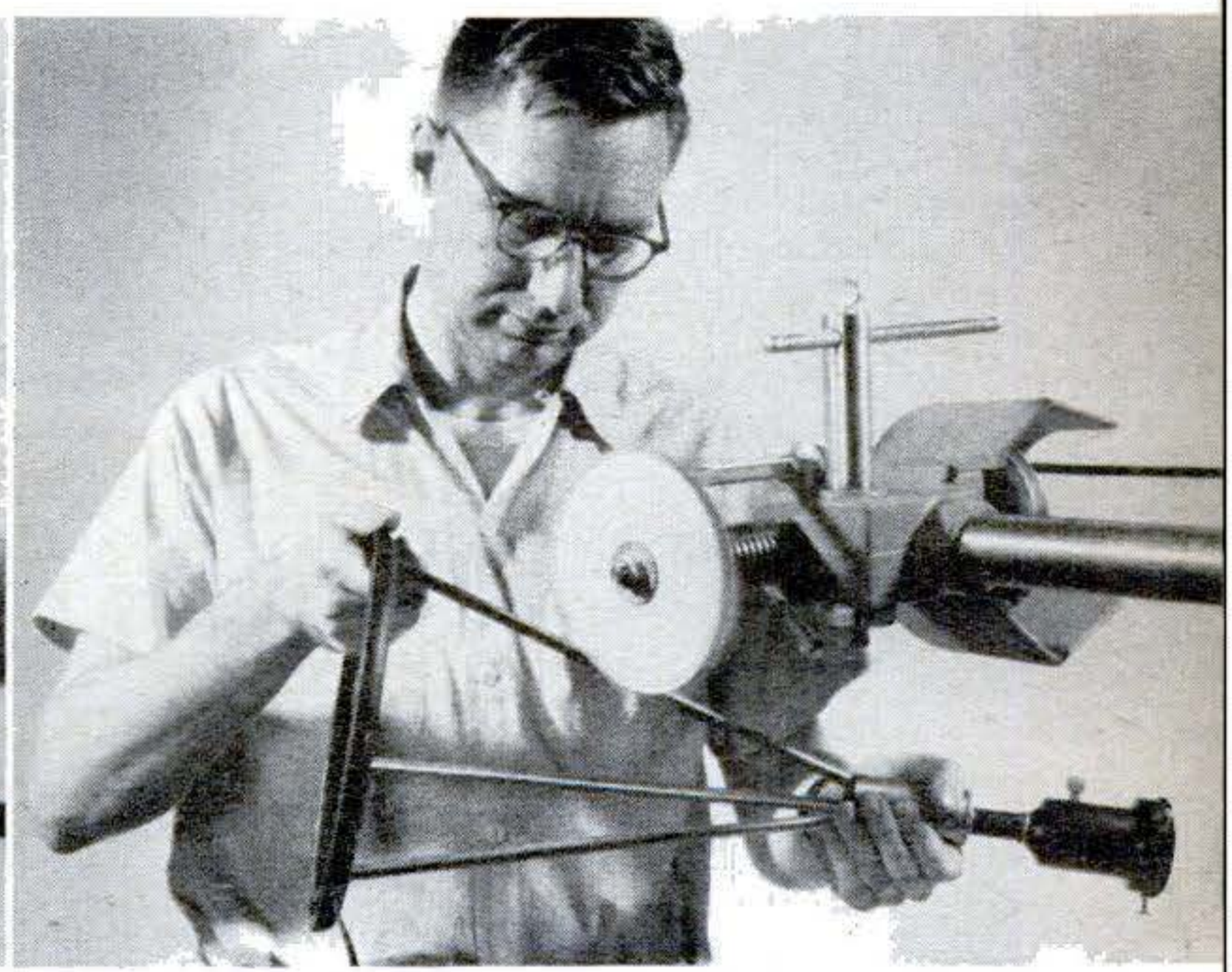
Positive indexing. Once the operator has squared the head of the drill on the arm—two setscrews lock it there—the rest is automatic. The head dependably clicks into place at 90 degrees.

Because of this positive index at 90 degrees, you can believe the protractor on the tool. A line scribed along the arm registers tilt on a ring marked in five-degree increments. Set the angle you want, and drill away. This means those awkward jobs—holes for splayed table legs, sockets for stair-rail spindles, sanding precise bevels—can be done without

a variety of shop jobs



AS A DISK SANDER, the drill has a big advantage: The quill can be used to feed the disk against the work at any angle for sanding perfect circles or for trimming duplicate parts.



BUFFING: Spindle hangs in space for unhampered buffing and polishing. All parts of this bulky lamp could be reached without interference from arm or column supporting the head.

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special jigs and troublesome angle measurements.

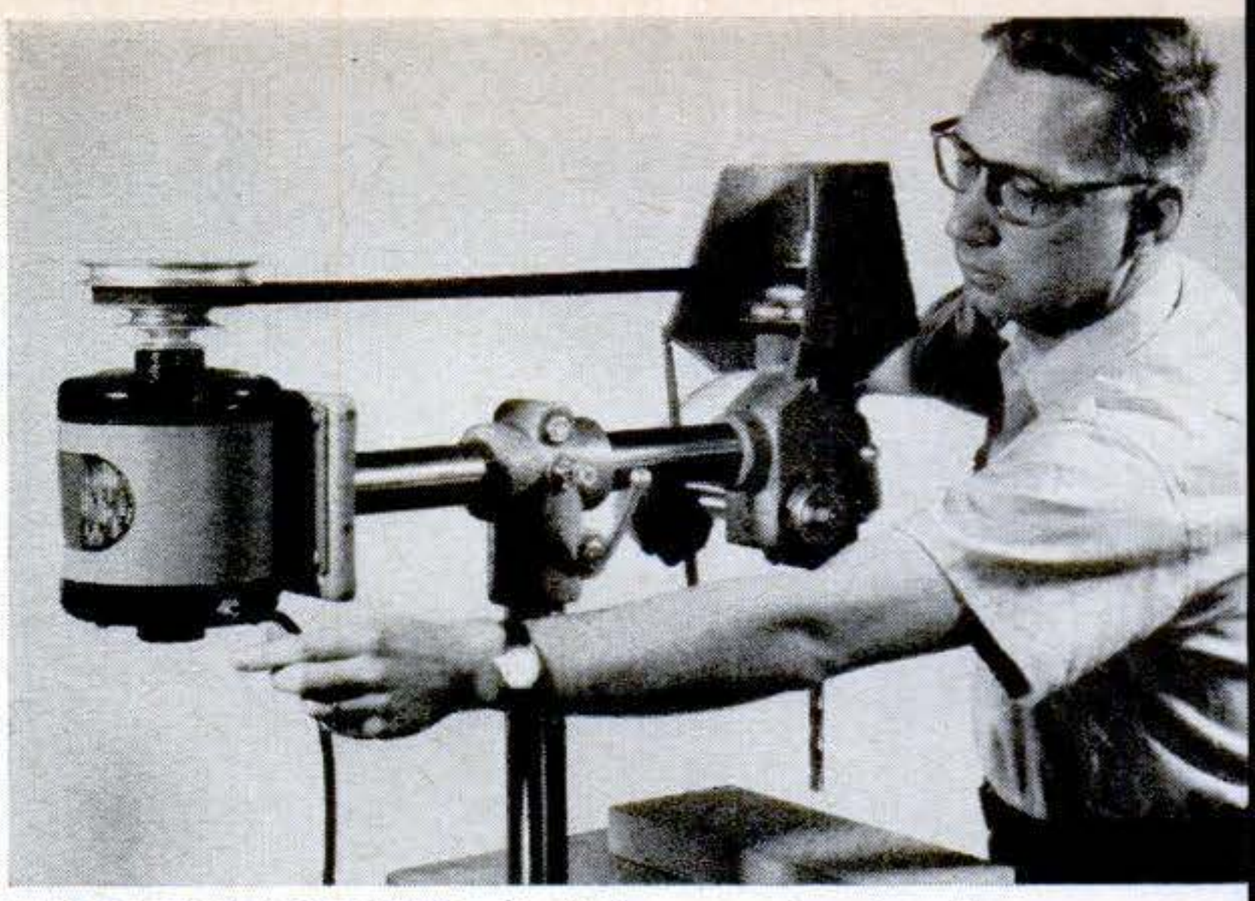
The plywood table that comes with the drill press is big enough—16″ by 24″—to give working room for the long arm. And the plywood top is meant to be expendable. Without the least misgiving, you can bore it for clearance, screw jigs to it, bolt guides on it anywhere, even drive nails into it. When it's battered beyond usefulness, make a new one.

For precise holes in metal, you unscrew four wingnuts and lift off the plywood. The cast-iron table has slots and side ledges to receive clamps.

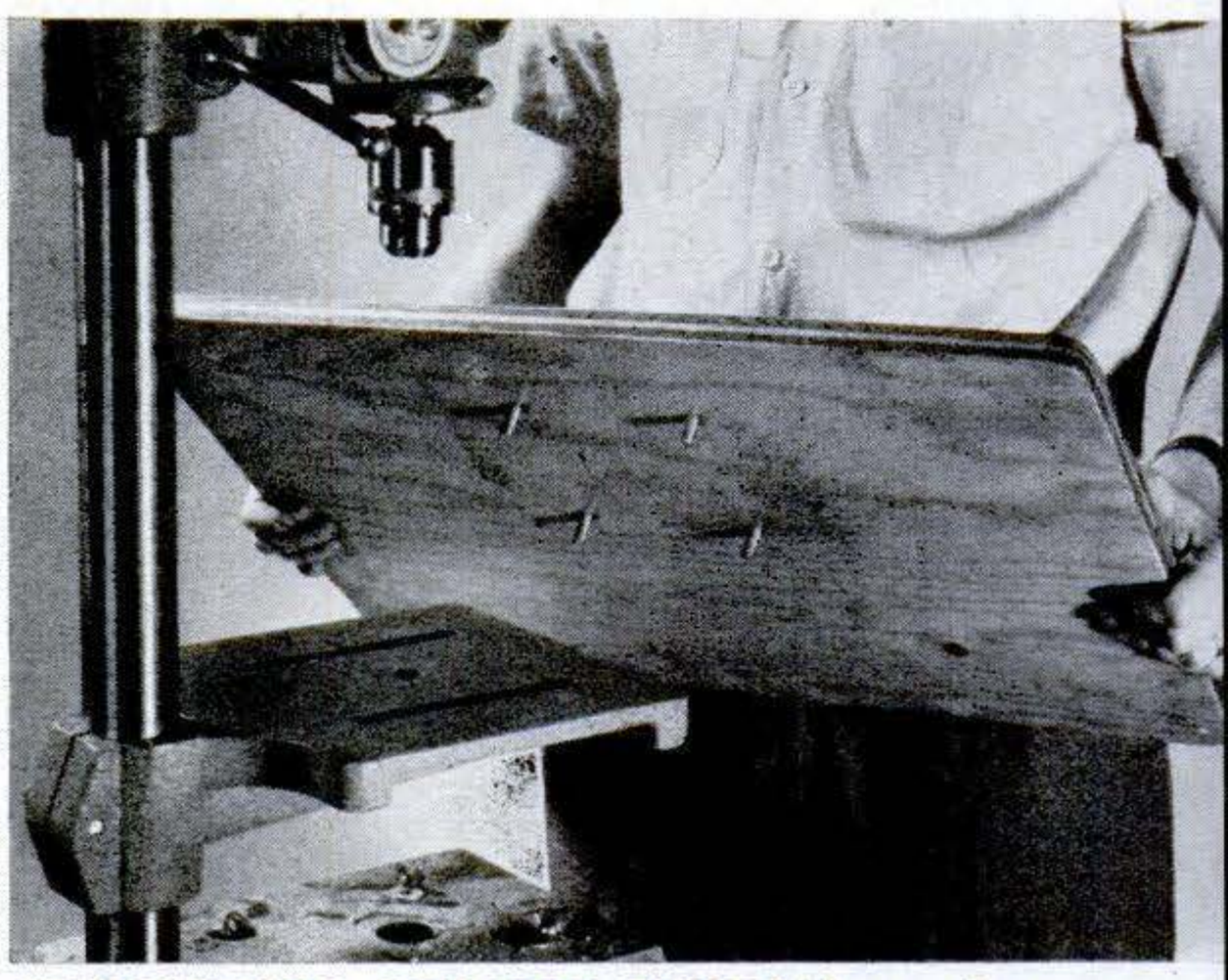
Extra spindles. The drill comes with a ½″-capacity chuck attached to the spindle. You can buy three extra spindles to hold just about any kind of cutting tool. One has a threaded and flanged work arbor for ½″-bore grinding or buffing wheels. Another is threaded to hold shaper cutters with a 5/16″ hole. The third ends in a sleeve adaptor to hold tools with a ½″-diameter shank.

All of the spindles extend the full length of the head and are grooved to float in the spindle pulley.

Accessories for the standard 11″ Delta drill and the new radial drill are interchangeable. The price tags aren't; the new drill sells for $89.50. This is $19.45 more than the old one cost—but seems little to pay for the world of difference in what the new tool can do.

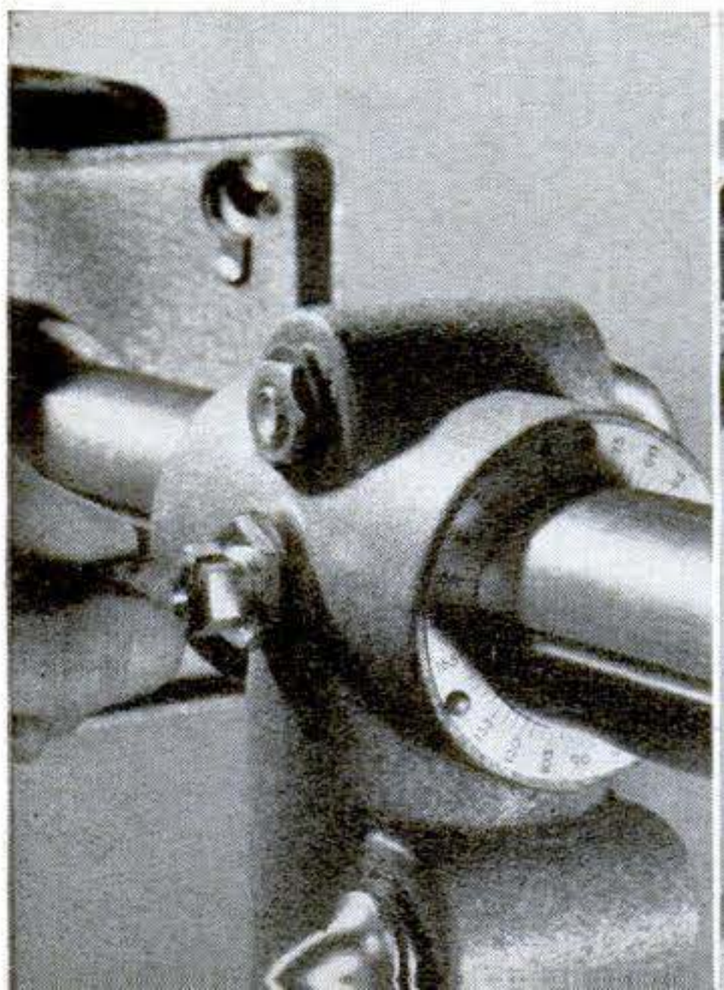


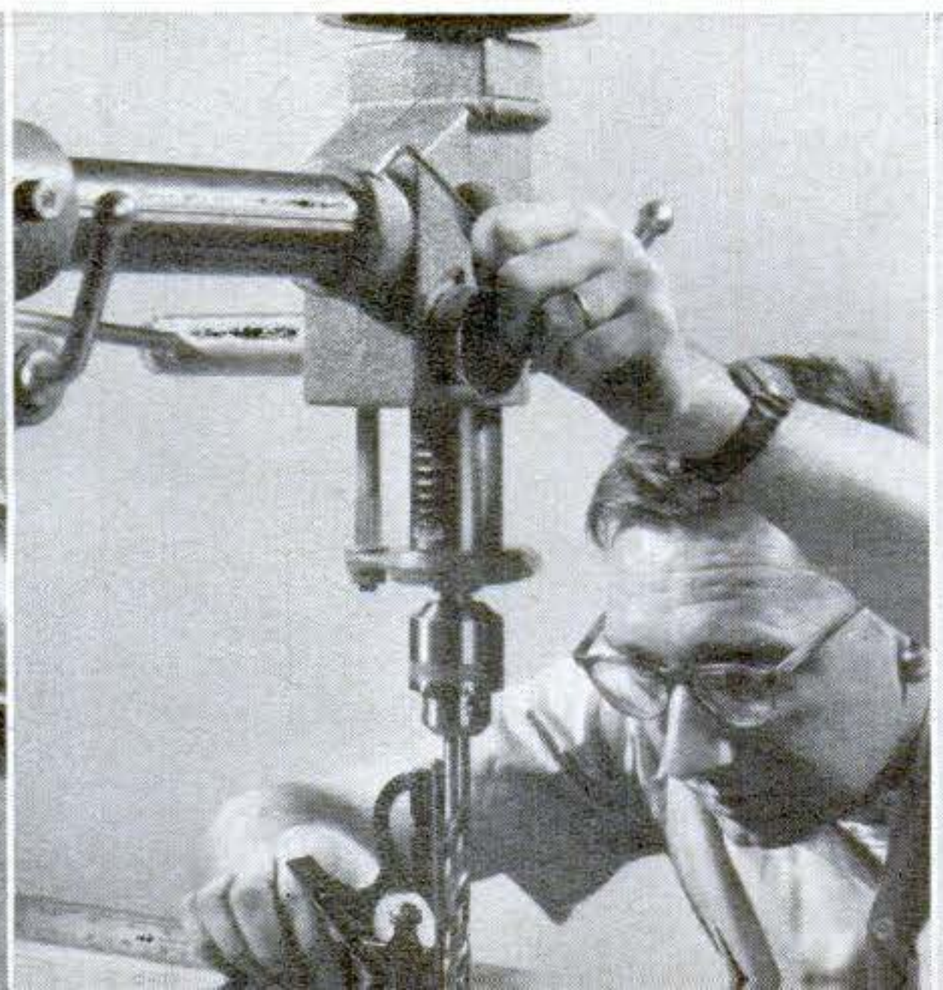
DISADVANTAGE HERE: Switch on motor is a long reach from the front of the drill press. The operator must lean dangerously close to the spindle, or leave his work to reach switch.

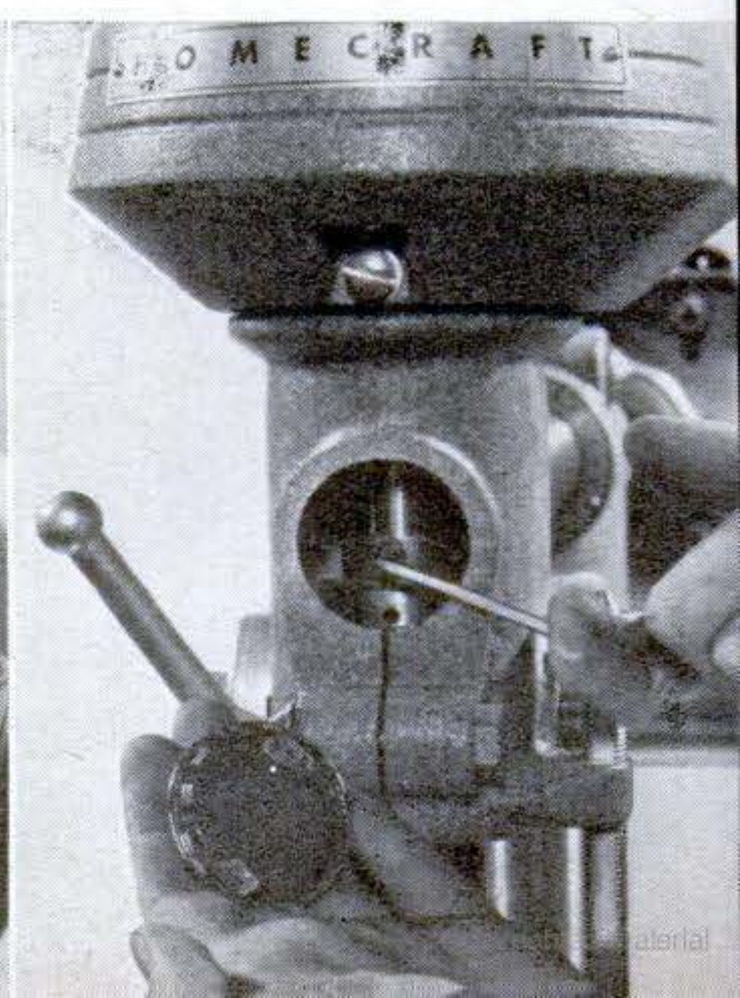


CONVENTIONAL CAST-IRON TABLE hides under expendable plywood top. Four wingnuts hold top to 8½″-by-9″ slotted, machined table used for precise metalworking. Rigid table doesn't tilt.

OPERATING ADJUSTMENTS: Spring-loaded key locks arm at 90 degrees by engaging milled groove. Pin must be pulled out (below, left) to let arm revolve and head tilt. A line scribed along opposite side of arm registers tilt on the protractor ring. Head-squareness (center) and belt-tension adjustments are combined; both can be made easier by removing belt first. Two setscrews lock head to radial arm. Removable nameplate (right) covers access hole for spindle collar. Delta offers four interchangeable spindles to handle different kinds of jobs.



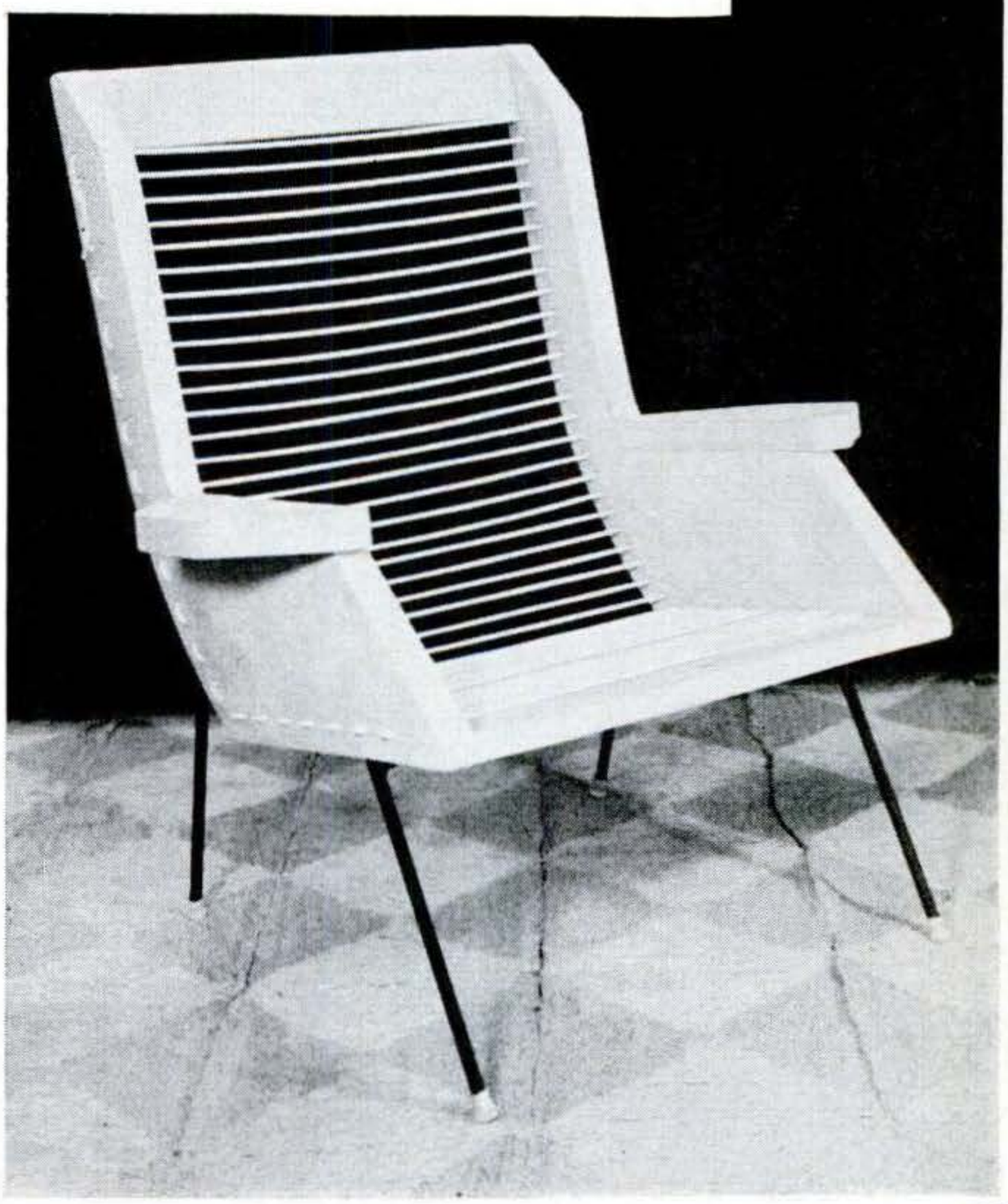




Two Chairs from One Man's Shop

By Paul Corey

Take your choice. Each one makes maximum use of a minimum amount of materials



NEED an extra chair—quick? Either of these two can be built in a hurry. And they're as stingy with materials as they are with working time.

Both chairs can be cut from single slabs of wood. After that, they're simple glue-and-screw jobs. The designs demand no precise joinery, and they can be varied without basic change.

Lay out all the parts of either chair before cutting any of them. Some share common outlines. This saves layout time but doesn't allow room for saw kerfs. However, dimensions aren't critical.

You can keep the kerfs small and the edges smooth by using a hollow-ground blade in your saber- or jigsaw. Clamp matching cut-out pieces together for edge-

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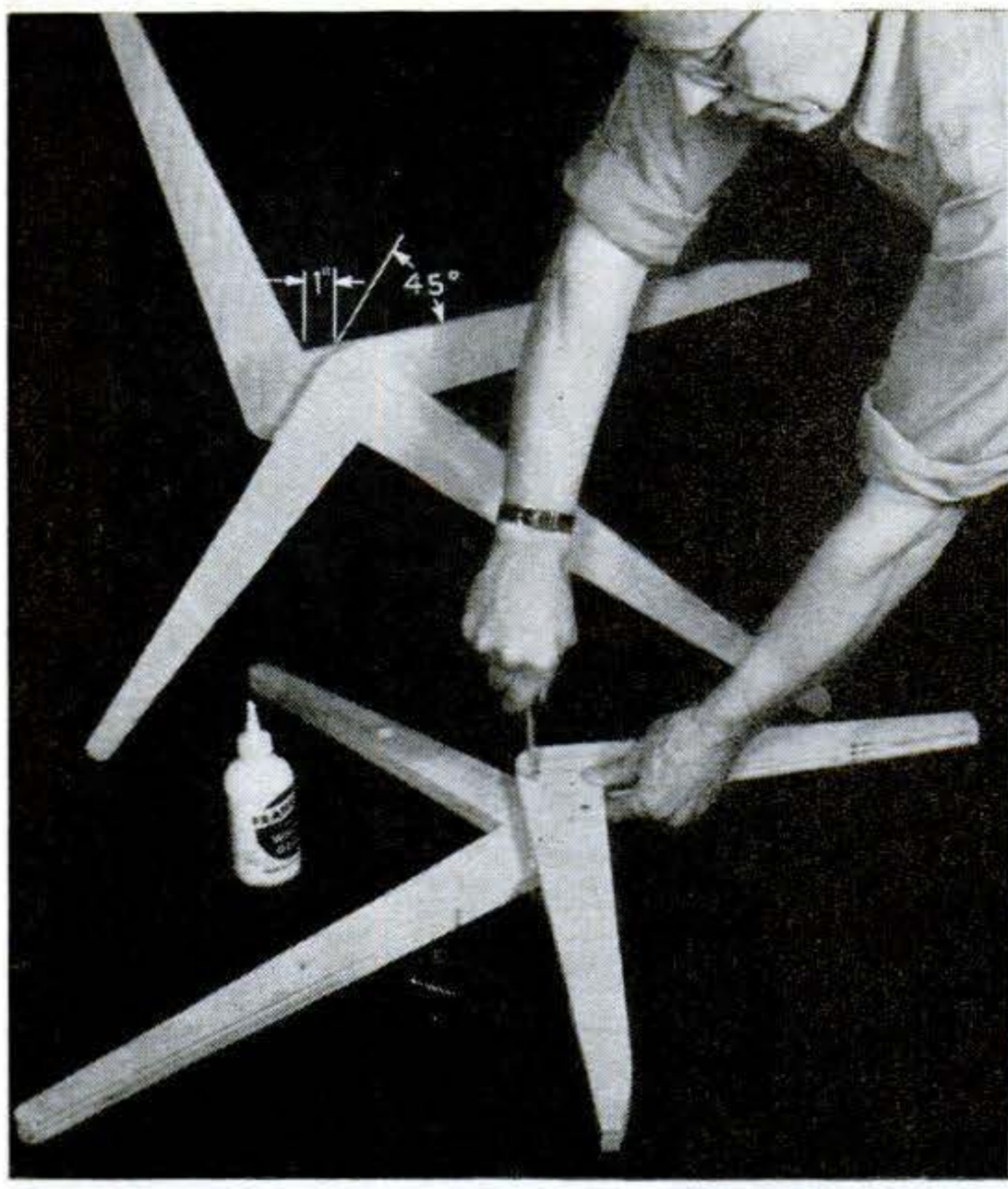
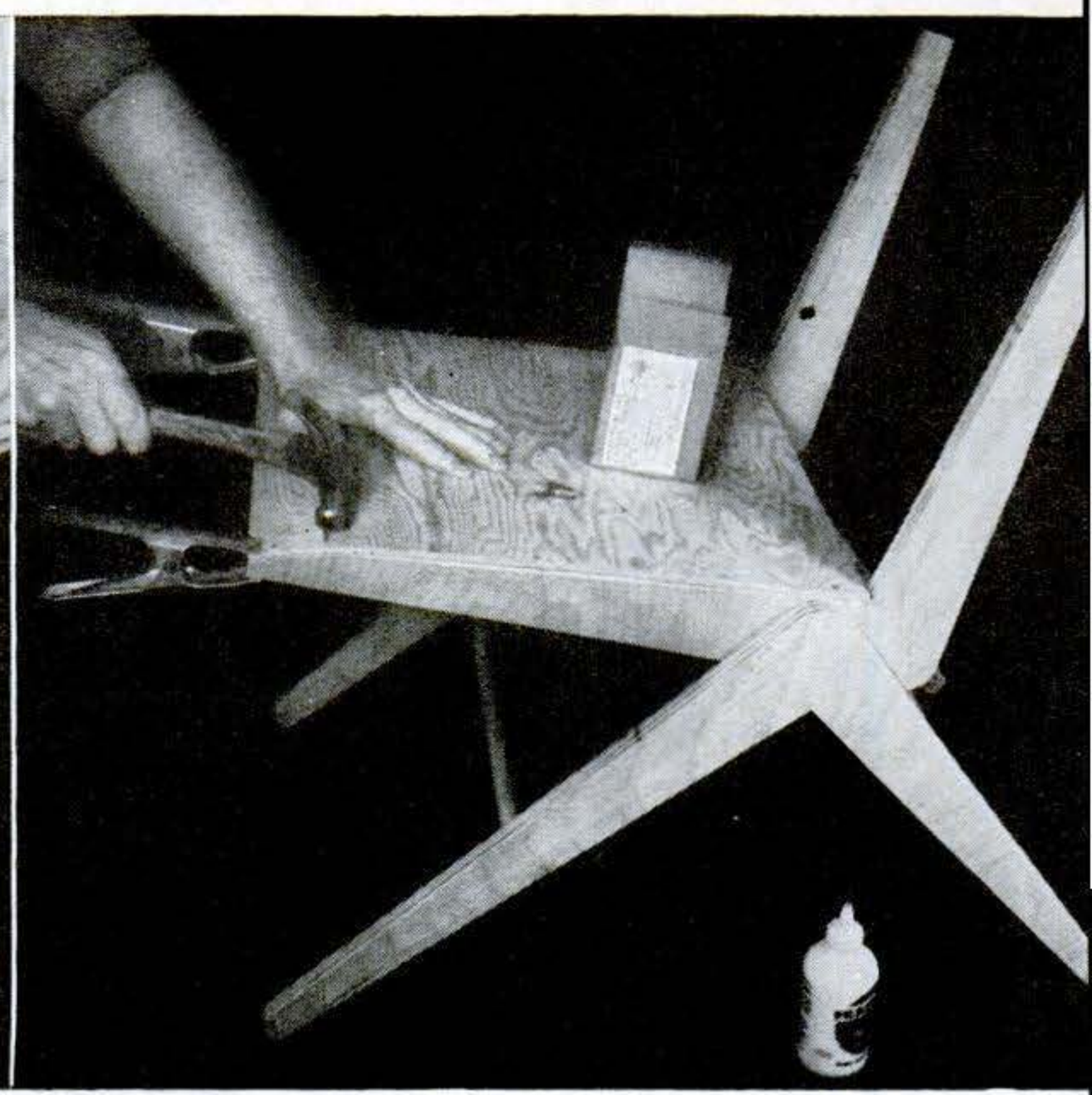
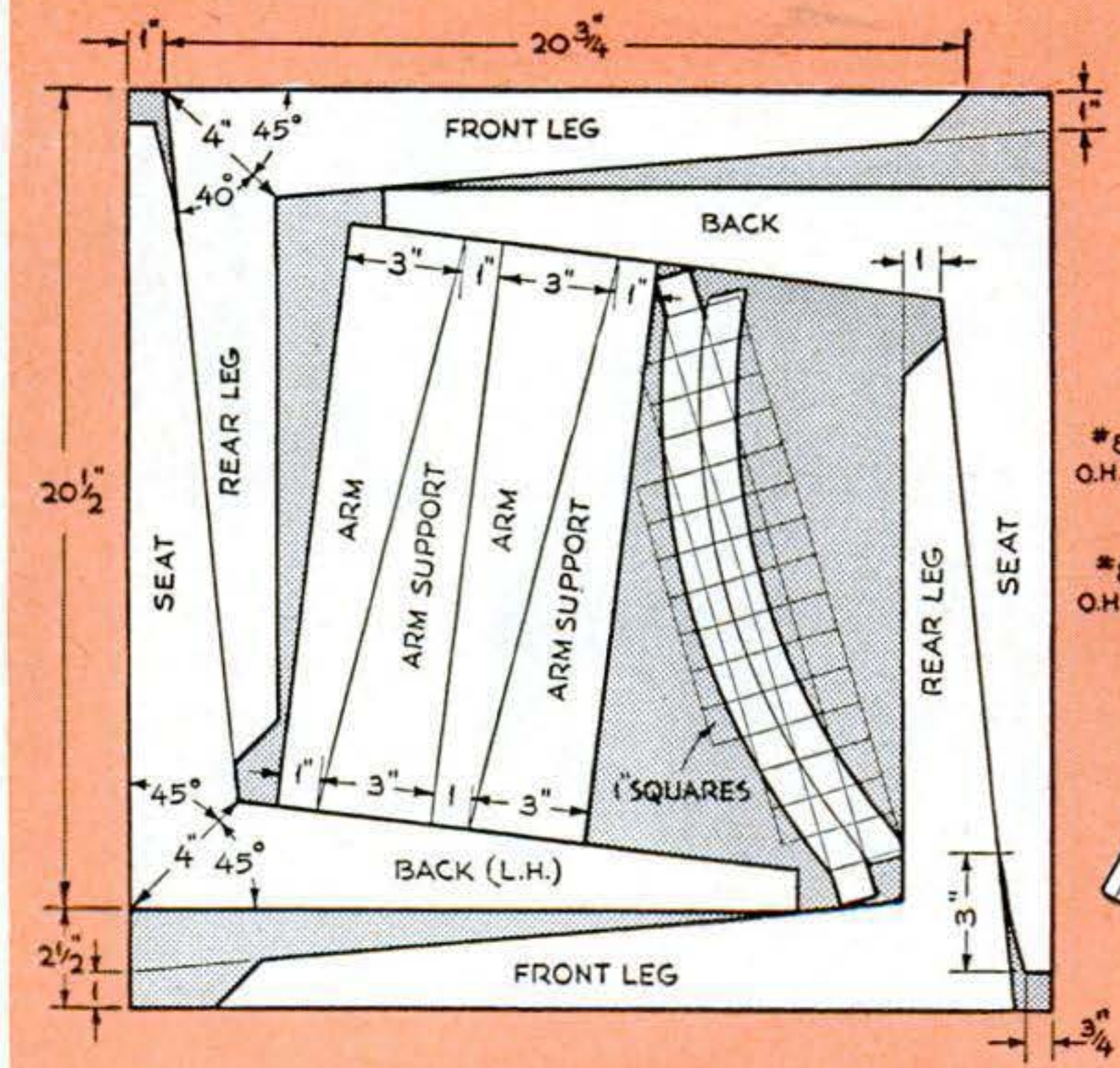
Plywood-chair construction is simple and fast; the

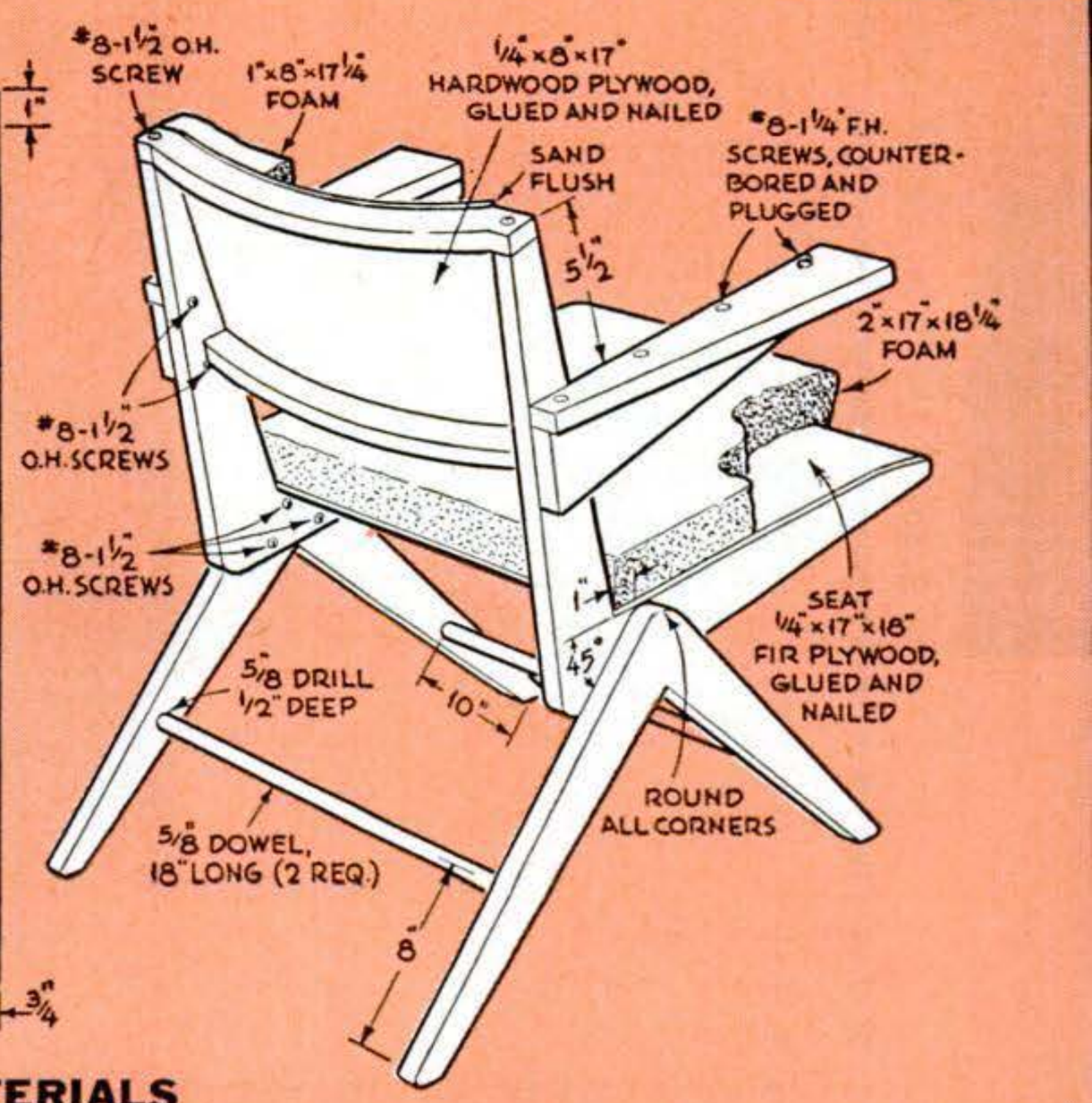


LEGS are fastened to L sides at 45-degree angle, with top of rounded corner flush with top of seat frame. Use glue, three 1½" screws ground off to prevent breaking through plywood.



SEAT goes on after legs are joined by gluing in the dowels. Kerfing the underside of seat front makes it easier to bend. Glue and nails are adequate fastening; pad will conceal heads.





LIST OF MATERIALS

1 pc 24"x24"x¾" hardwood plywood
1 pc 8"x17"x¼" hardwood plywood
1 pc 18"x17"x¼" plywood
2 pcs 18" dowel, ⅝" dia.
12 No. 8 oval-head wood screws, 1½"
2 No. 8 flat-head wood screws, 1½"
8 No. 8 flat-head wood screws, 1¼"
1 pc 18¼"x17"x2" urethane foam
1 pc 17¼"x8"x1" urethane foam
Glue, finishing materials to suit

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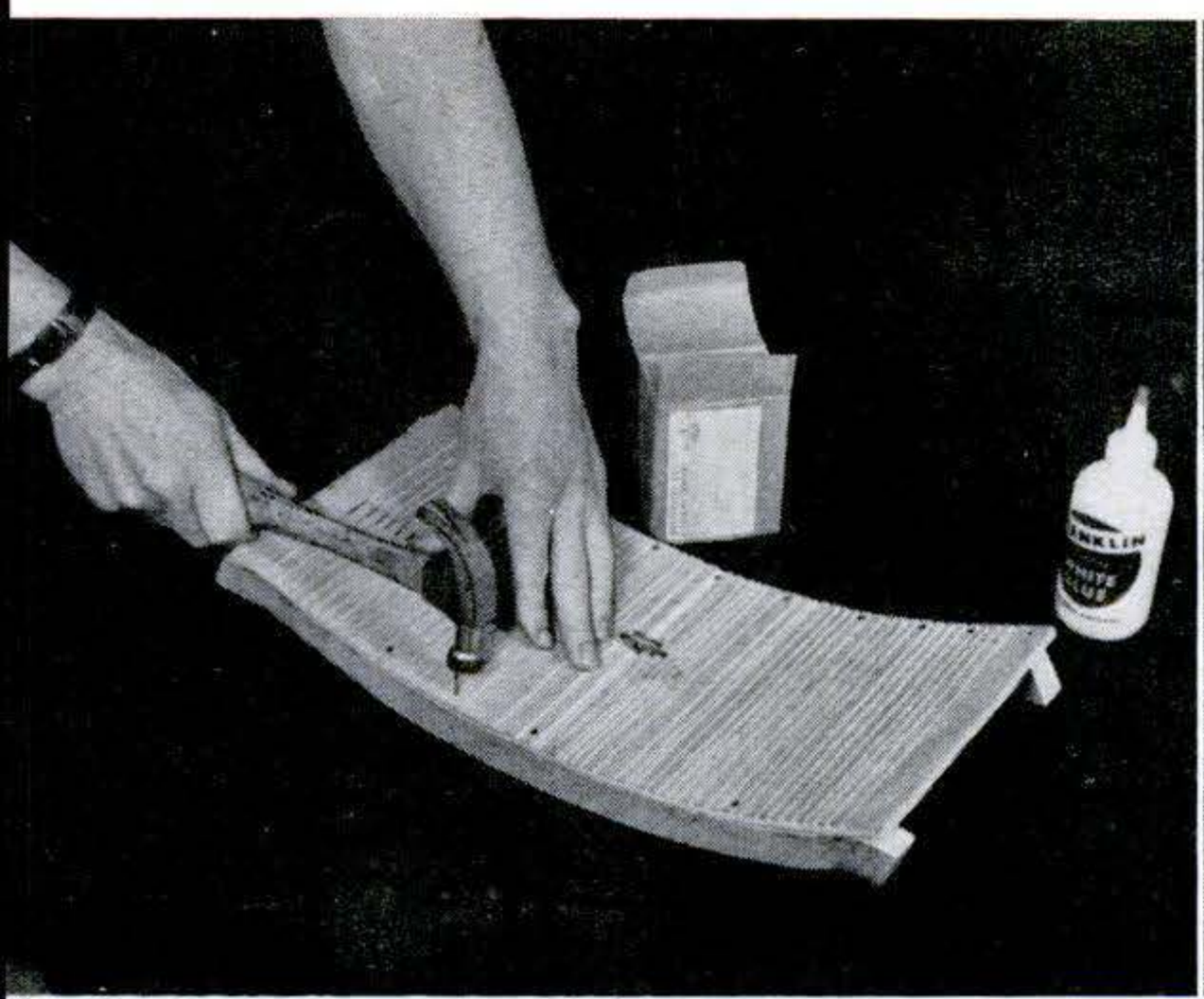
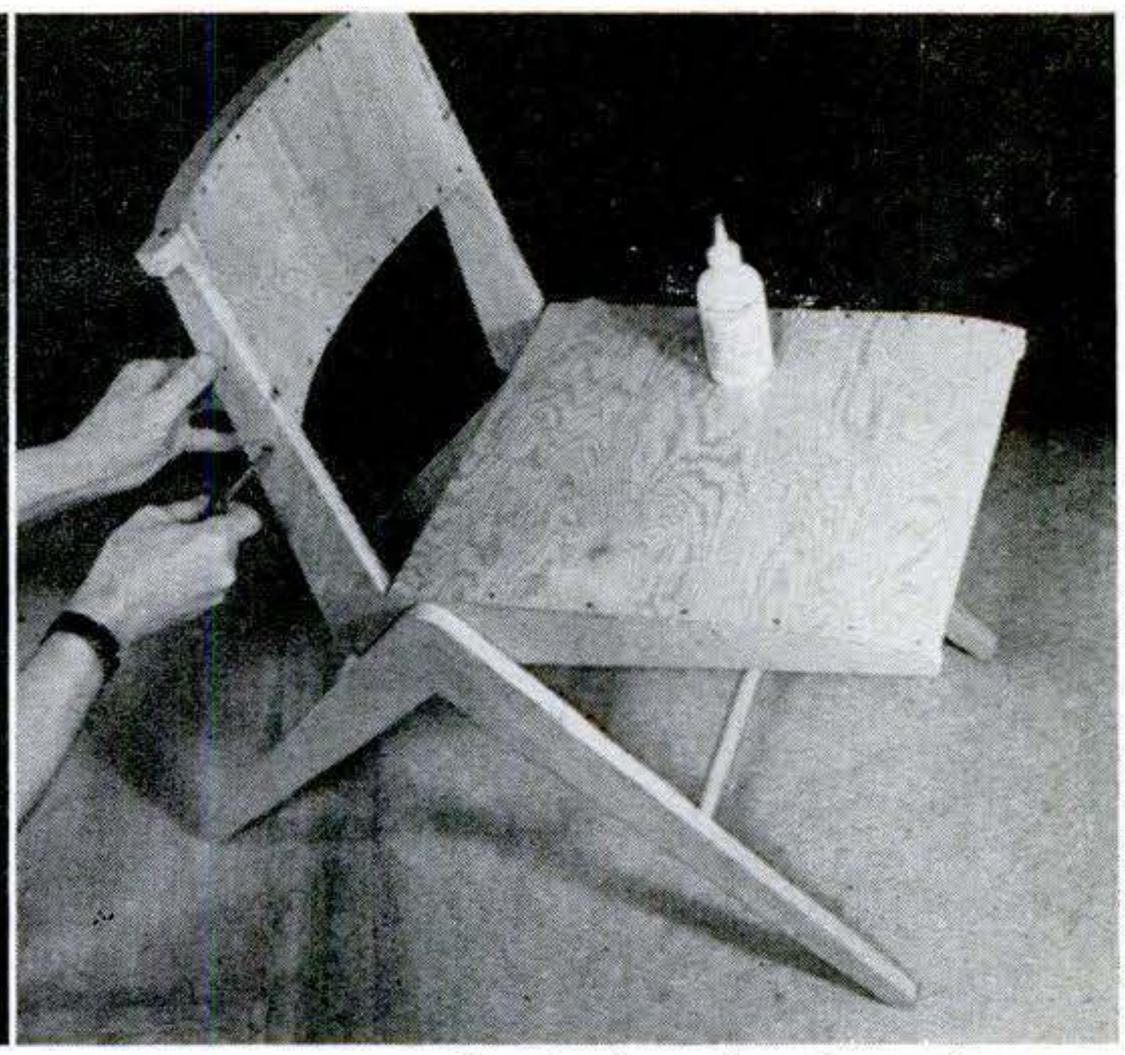
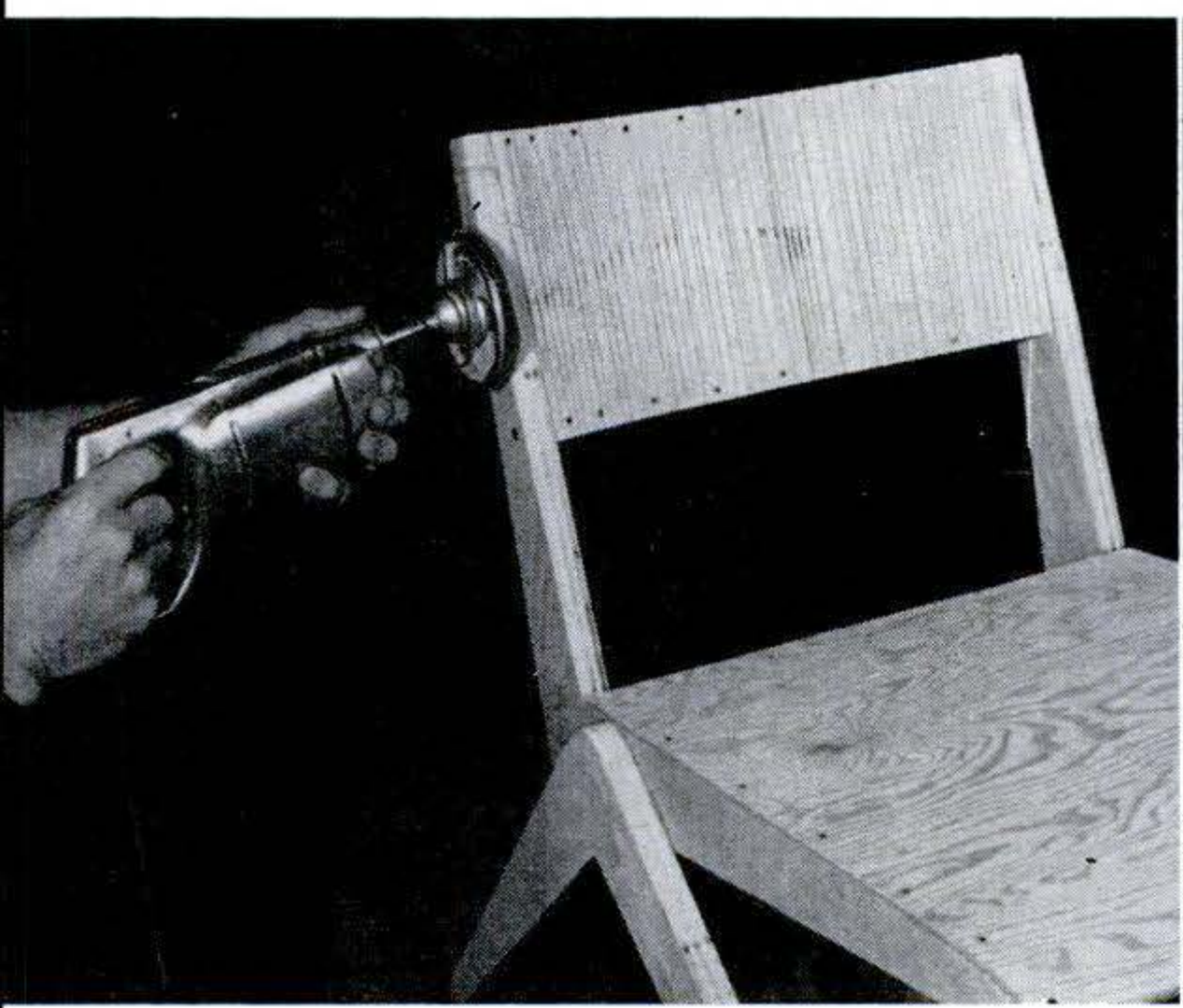
design saves work time as well as material cost



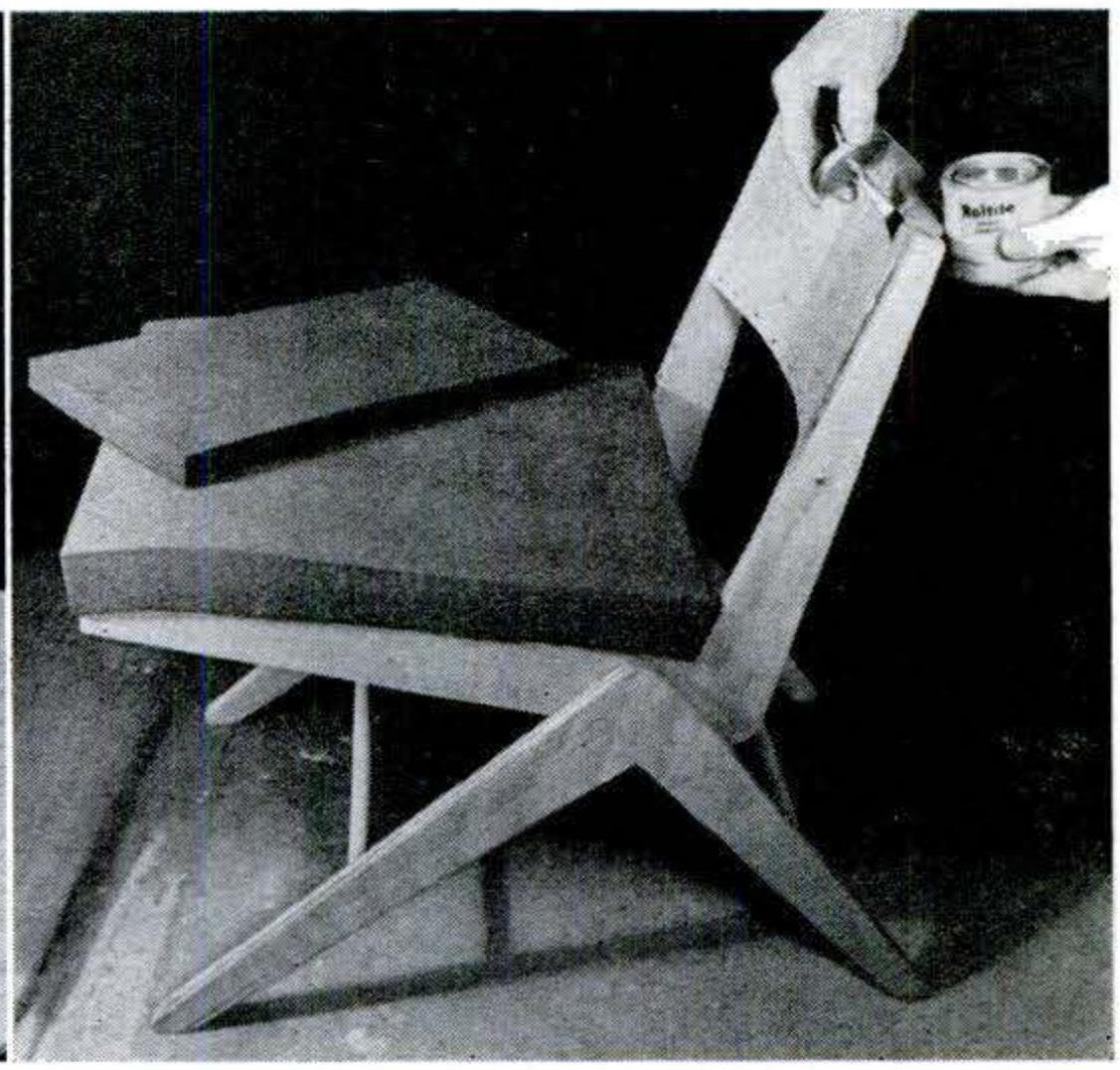
BACK REST can be trimmed to size after it's assembled with nails and glue. Top frame extends over side frames; the bottom frame and plywood backrest will fit between the sides.



PLYWOOD BACK fits flush with sides at bottom, protrudes at top where frame laps sides. Back is joined with screws through top and in from sides; arms cover flat-head screws in sides.



FINAL SHAPING with sander flattens protruding plywood edge, cuts the back frame flush with the sides. Sharp corners of plywood edges should be softened with a few strokes of sandpaper.



ATTACHING FOAM PADDING completes chair. If chair is finished before padding, use care to keep adhesive away from finish; the solvent in the cement can damage many finishes.

sanding with a drum or belt sander. This will insure perfectly matched parts as well as smooth edges.

And remember that parts are matched, not identical. For every right-side piece, there's a corresponding left-side one. Mark them for identification—you may save material as well as embarrassment.

The finish can be varied to suit time and taste. If you plan to use the corded chair outdoors, stick to a weatherproof finish. A penetrating sealer-stain will give good service.

The plywood chair has 10 major parts. All of these can be cut out of a single 24"-by-24" panel of ¾" hardwood plywood, good on both sides.

Screw the parts together with 1½" No. 8 wood screws. Use caution, however. The 1½" screws can break through the 1½" thickness of the doubled ¾" pieces.

You can play safe by withdrawing part-

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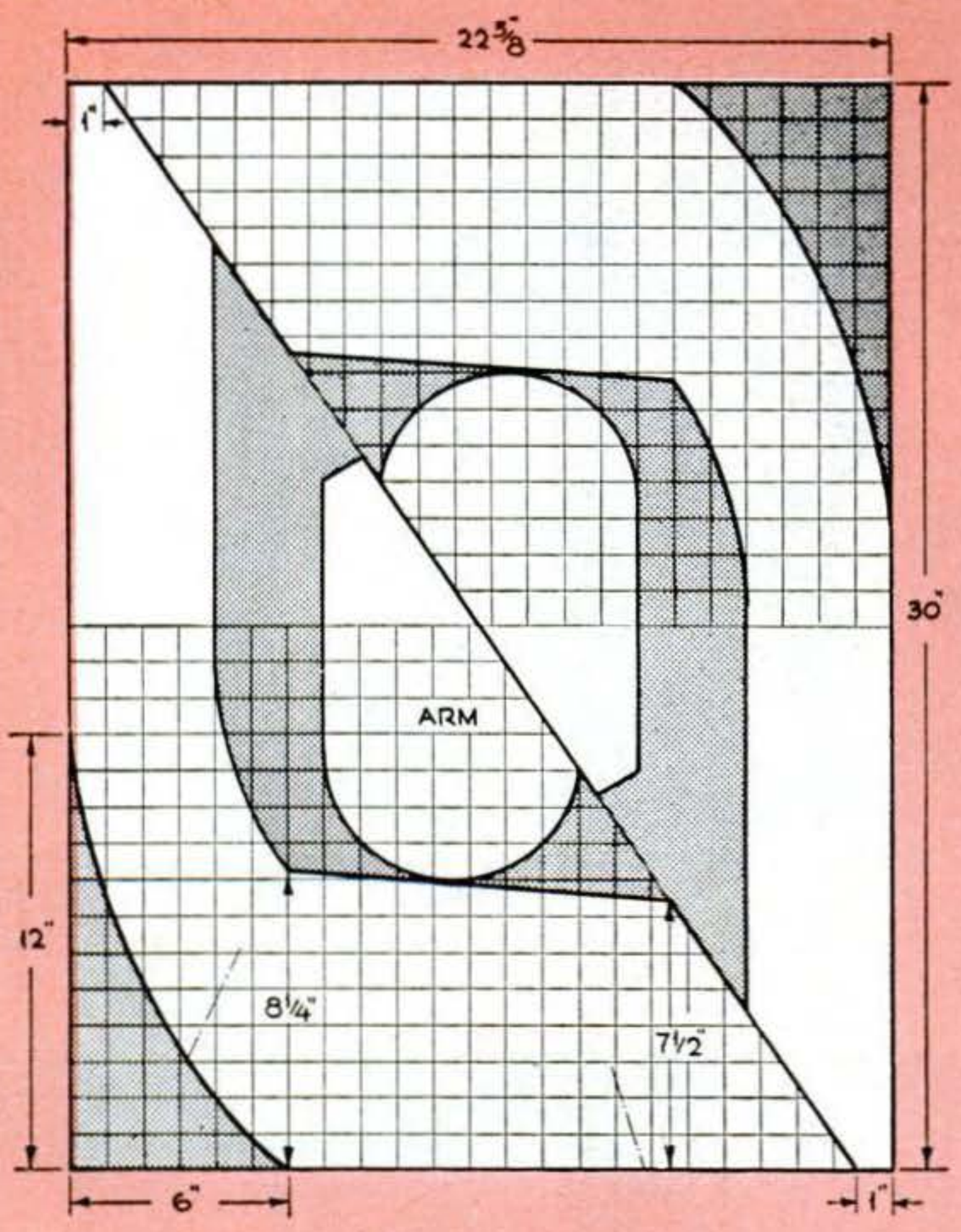
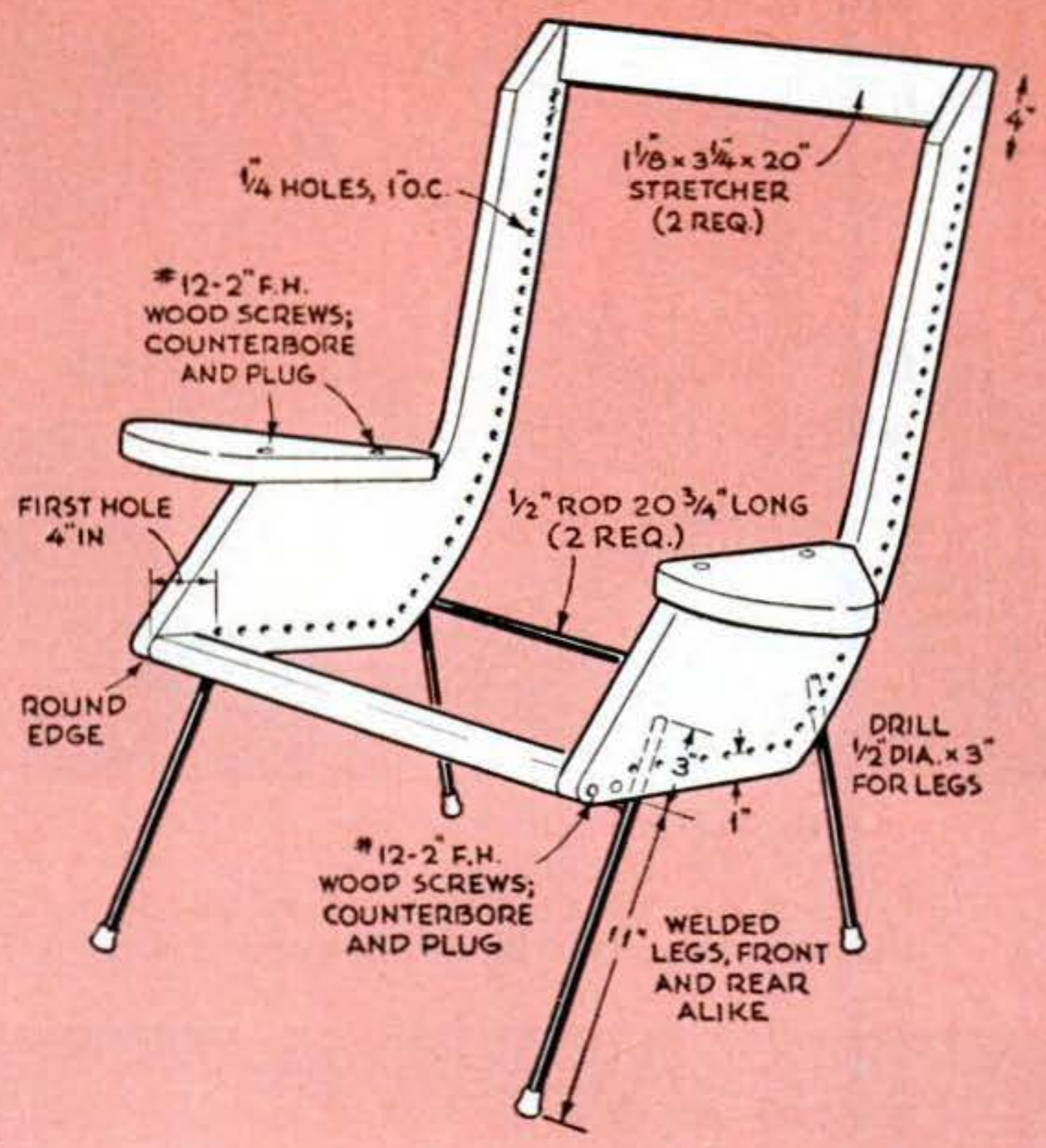
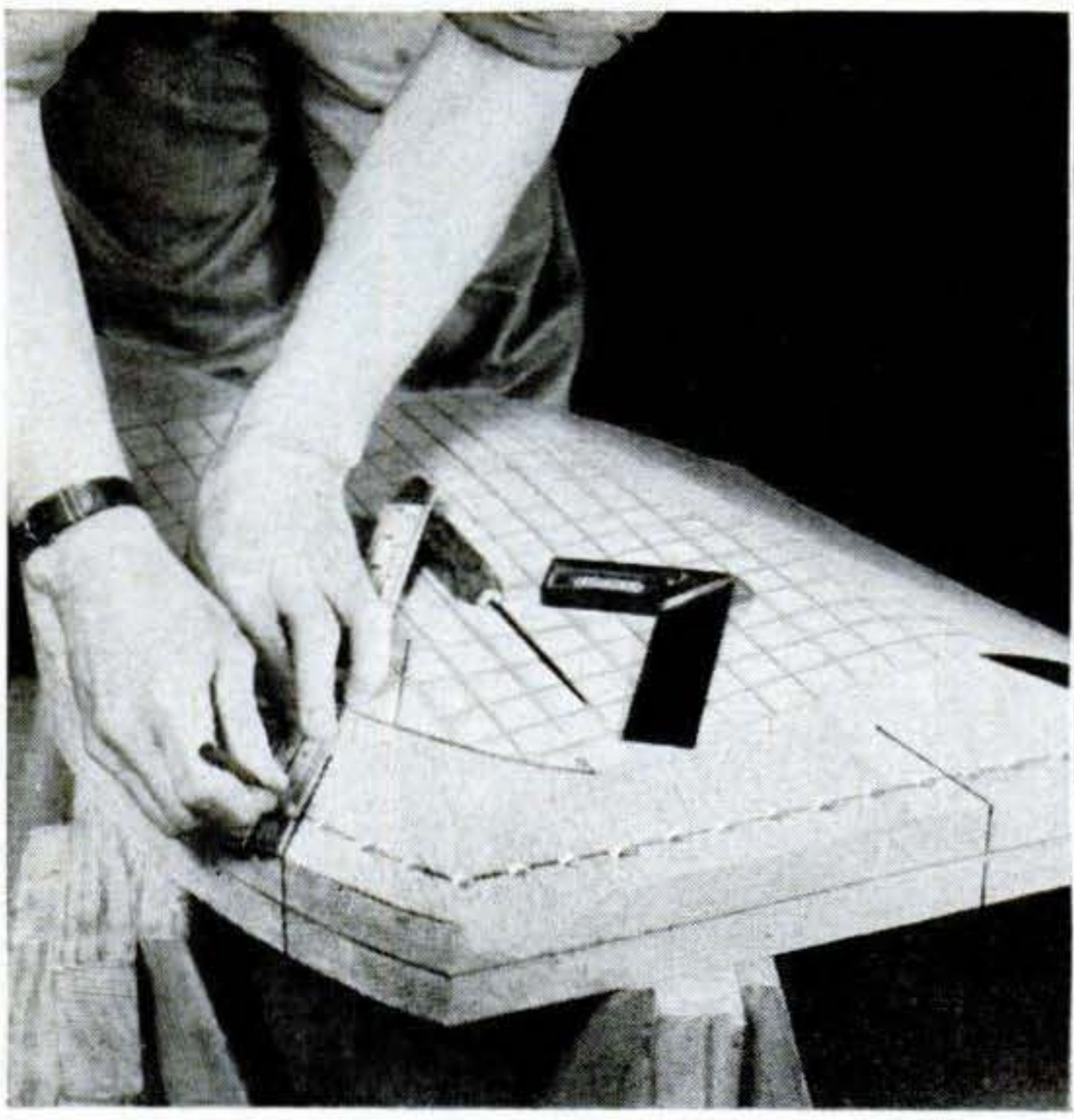
Both sides of the corded chair come from one slab



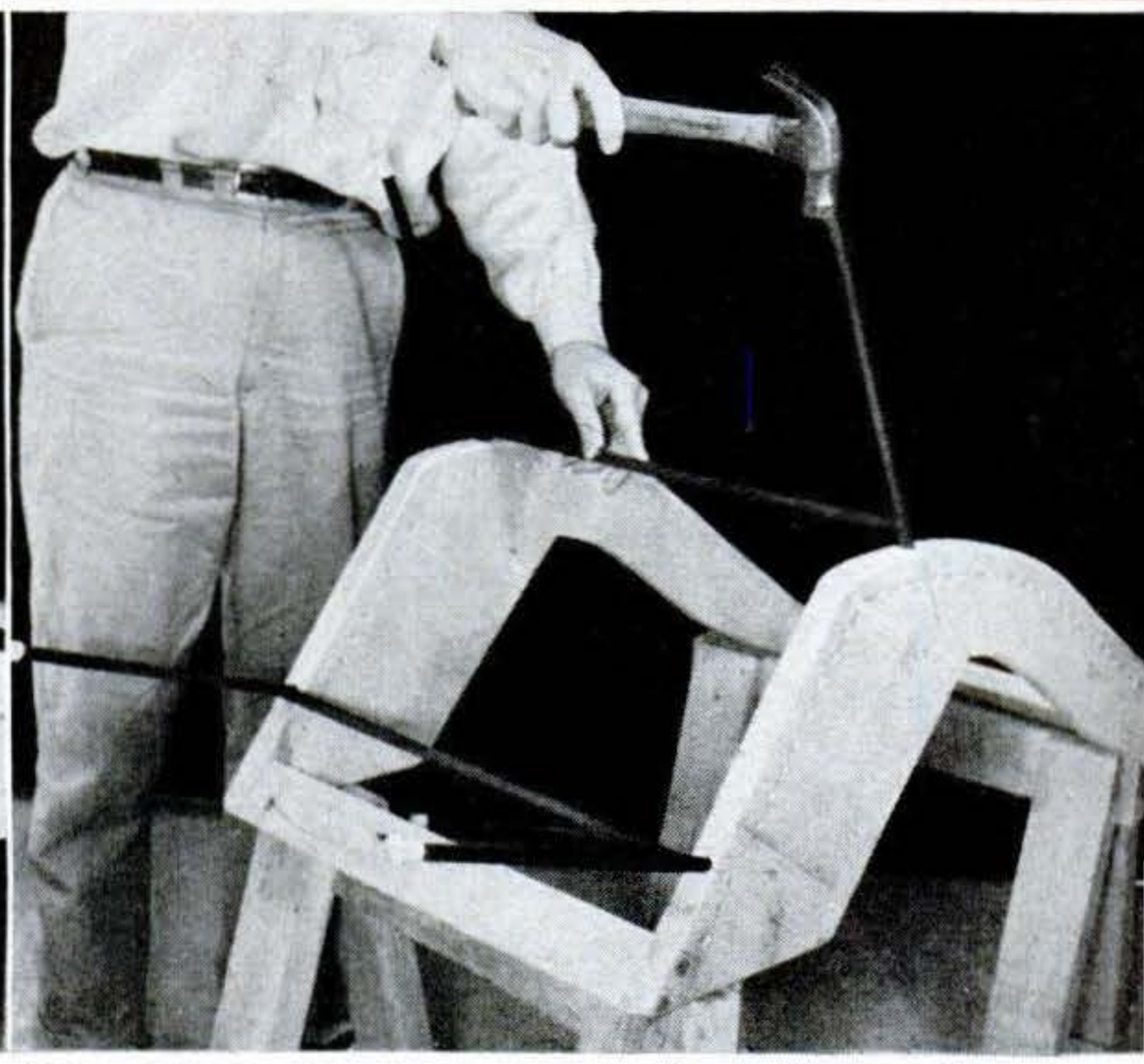


LIST OF MATERIALS

1 pc 22⅝"x30"x1⅛" hardwood
2 pcs 3¼"x20"x1⅛" hardwood
4 14" steel rods, ½" dia.
2 20¾" steel rods, ½" dia.
12 No. 12 flat-head wood screws, 2"
4 rubber furniture tips, ½"
80' plastic clothesline
Glue, finishing materials to suit



PUNCH THROUGH CARDBOARD TEMPLATE with an ice pick or awl to transfer angled line marking holes for legs. Drill the holes parallel to the line, spacing them carefully to fit the legs.



LEGS PENETRATE CHAIR SIDES 3" to give sturdy support. The holes must be bored true to prevent bind and subsequent splitting. Use a slightly undersize drill to insure a snug fit.

Copyrighted material

ly driven screws and grinding them to $1\frac{7}{16}''$. Then replace them and drive them all the way in.

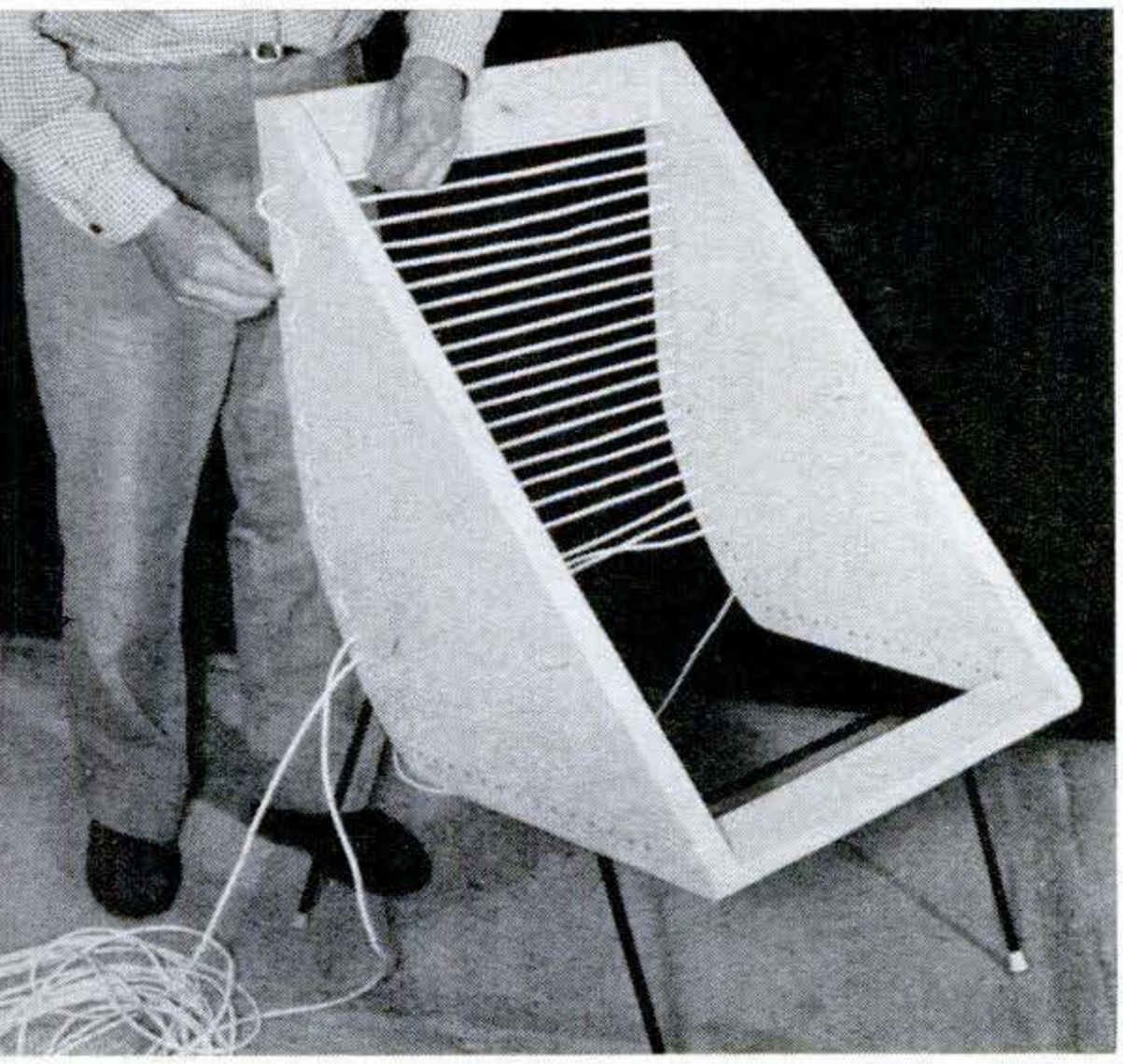
The plywood chair is "upholstered" with foam. This material is easy to clean, and in dark colors looks well without further covering. Attach it with rubber cement and it'll be ready for immediate use.

The corded chair starts from a panel 22⅝" by 30", glued and doweled together from "five-quarter" lumber. Or you can laminate sheets of plywood with contact adhesive to get the 1⅛" thickness needed. If you use lumber, use stout stuff—oak, ash, or maple.

Legs are ½" steel rod. Smooth reinforcement rod will do. Each chair will take four 14" and two 20¾" lengths. The price of this steel and the cost of welding it into two H shapes probably won't top $2. Before installing the metal legs, give them a coat of flat-black enamel and fit them with rubber tips.

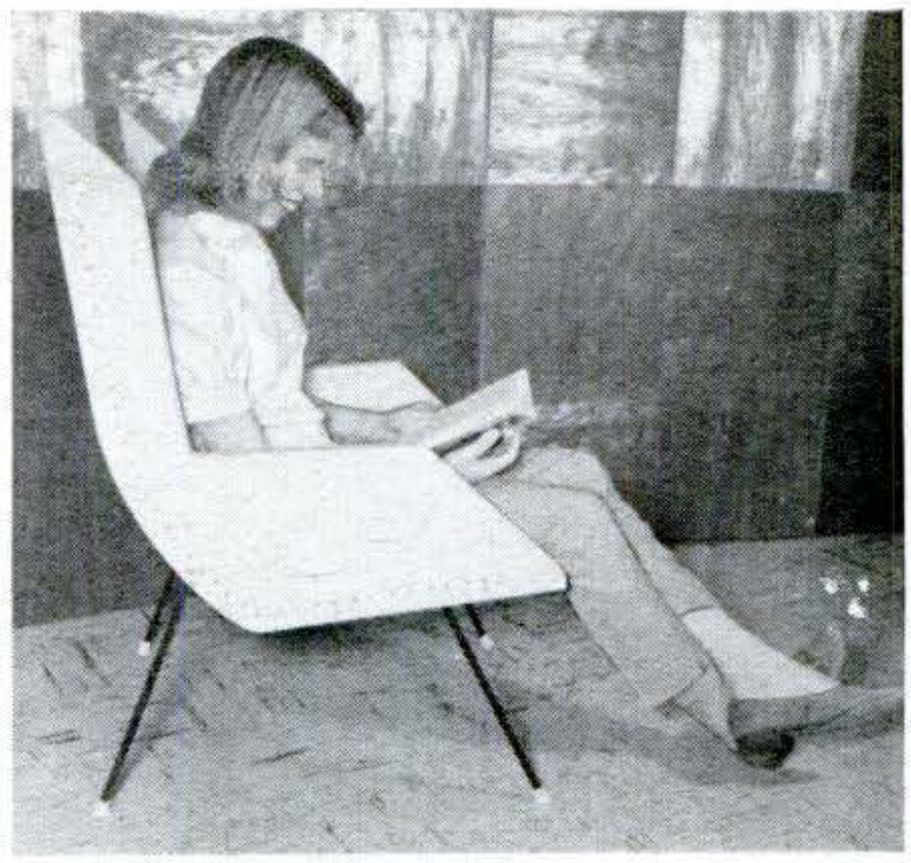
The plastic clothesline cording can be retensioned at any time. Starting at the back of the seat, tug at the center of each strand, hand-over-hand. This will work the slack to the ends of the cord, which are secured under loops on the outside of the chair.

If you prefer colorful furniture, you can paint the chair and use clothesline of a contrasting hue.



START WEAVING at bottom of seat back, working upward and downward from center of cord for best tension. Tuck the ends of the cord under loops on outside of frame to secure them.

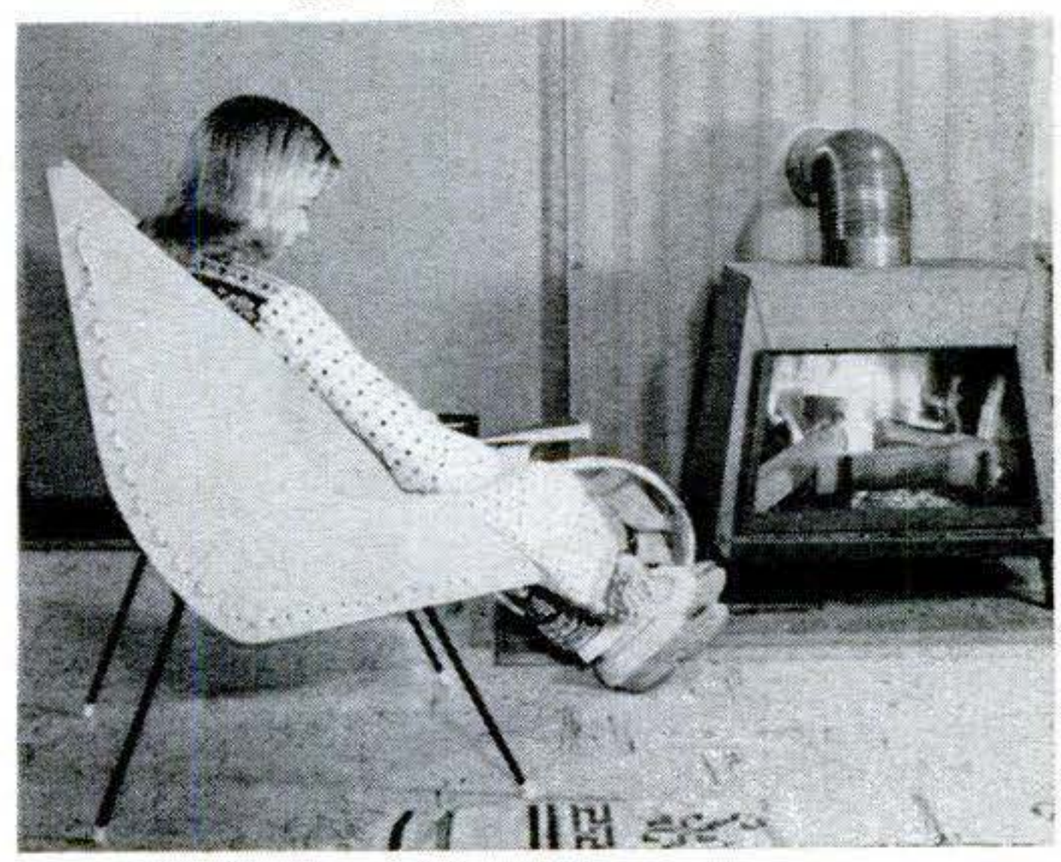
Design can be varied to fit the need or the user



Deep notches in slab halves make chair with narrow arms.

Adding wide arms makes handy spot for cups and ash trays.

Without cut-outs for arms, chair is deep, cozy seating.



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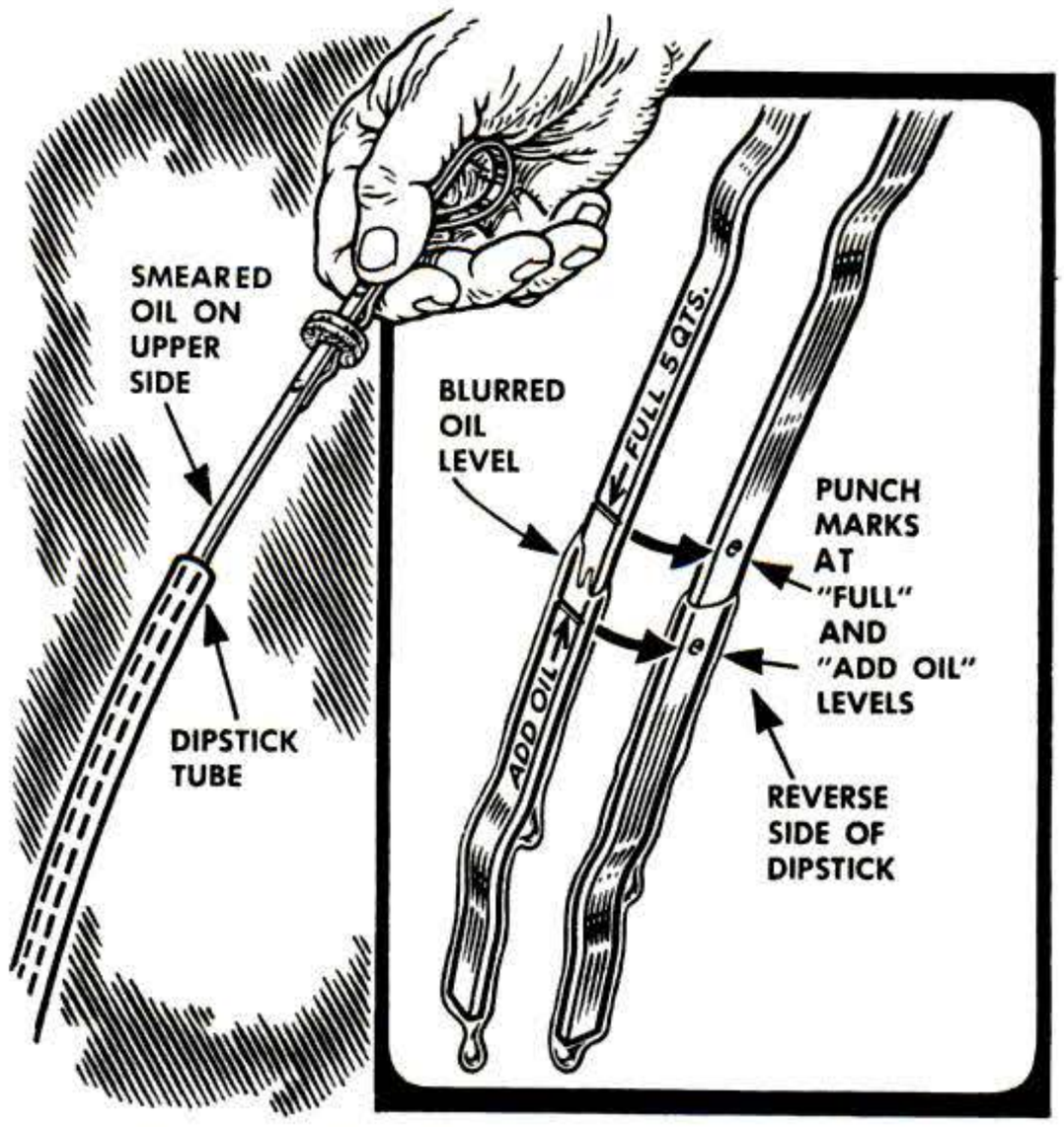
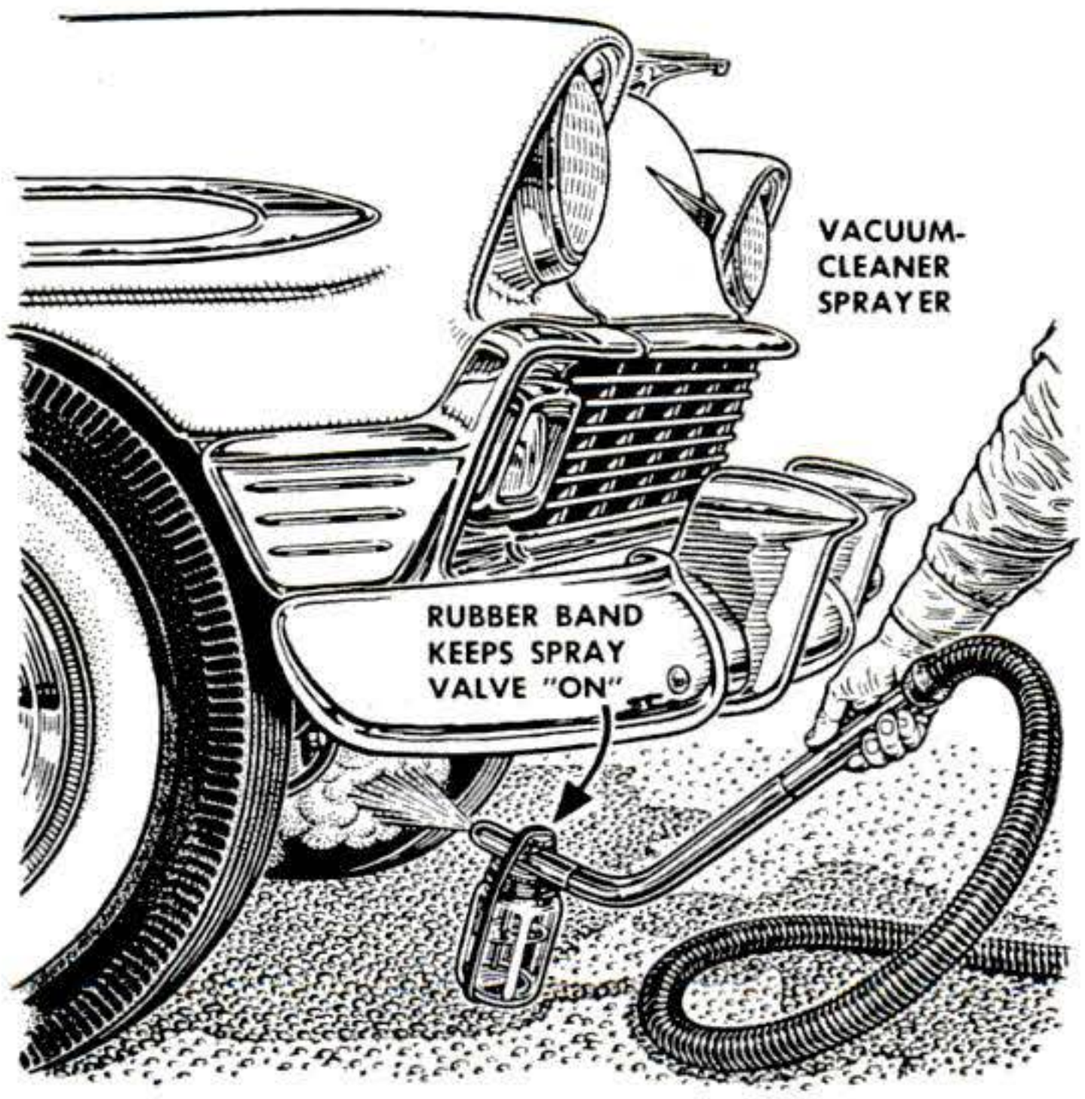
Hints from the Model Garage

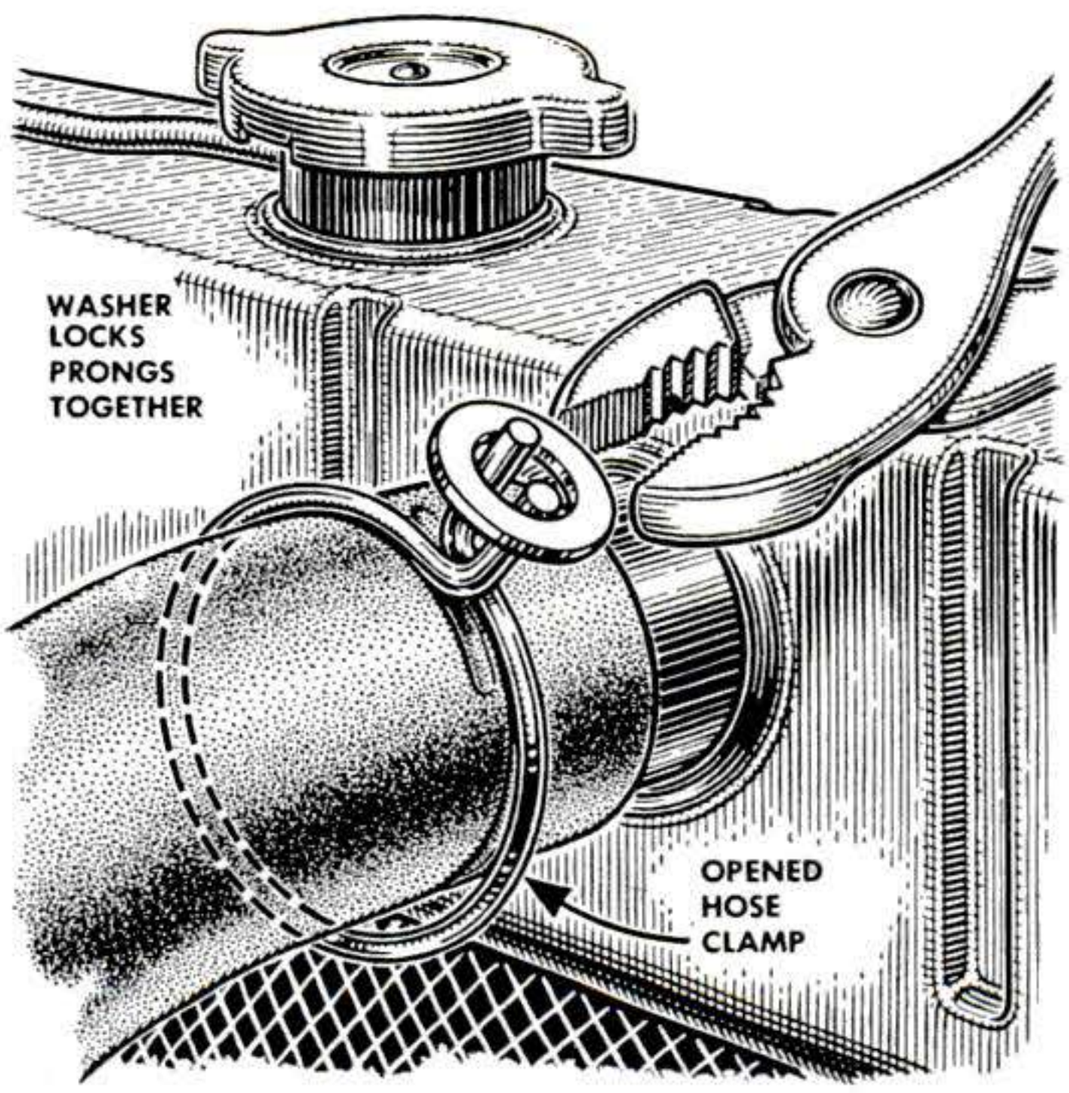
For cleaning spark plugs, a piece of spiral saw blade chucked in a drawing pencil makes a handy tool. It's especially good for scraping inside the plug. Sharpen the tip for best results. Shim the other end with tape to fit the chuck.



Reading a dipstick is easier if you prick-punch marks at the "full" and "add oil" levels on the reverse side. The lettered side of a late-model stick often gets smeared with hot oil when withdrawn from the curved guide tube.



To degrease the underside of a car, use the spray attachment of a household vacuum cleaner to apply kerosene. A rubber band will keep the valve open so you can reach under the car. Let the kerosene soak in, then hose off the dirt.



To hold a hose clamp open slip a washer over the prongs. The open clamp will then be easy to remove and replace without special tools. Prongs can be compressed for the washer by squeezing them together with ordinary pliers.

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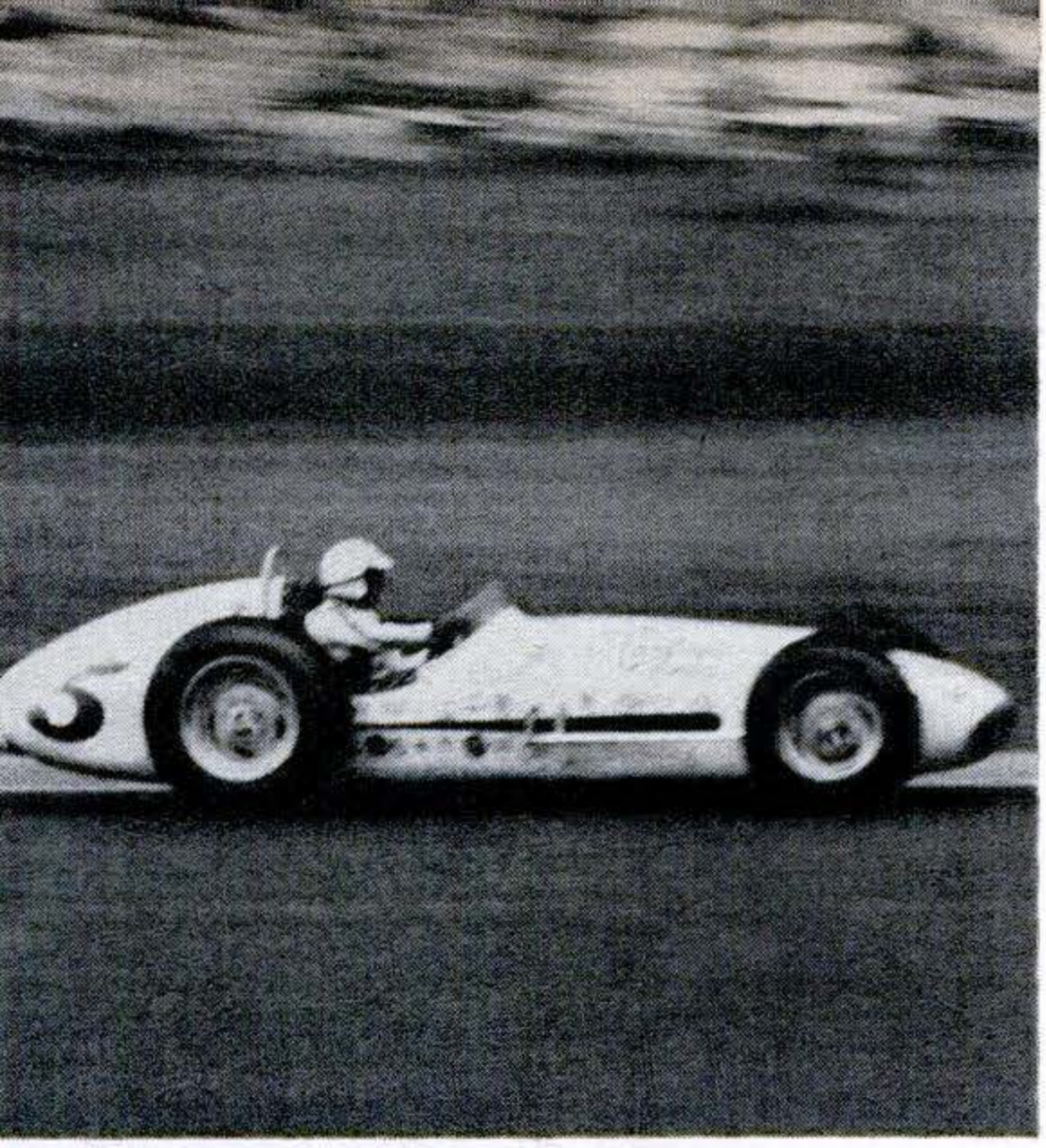
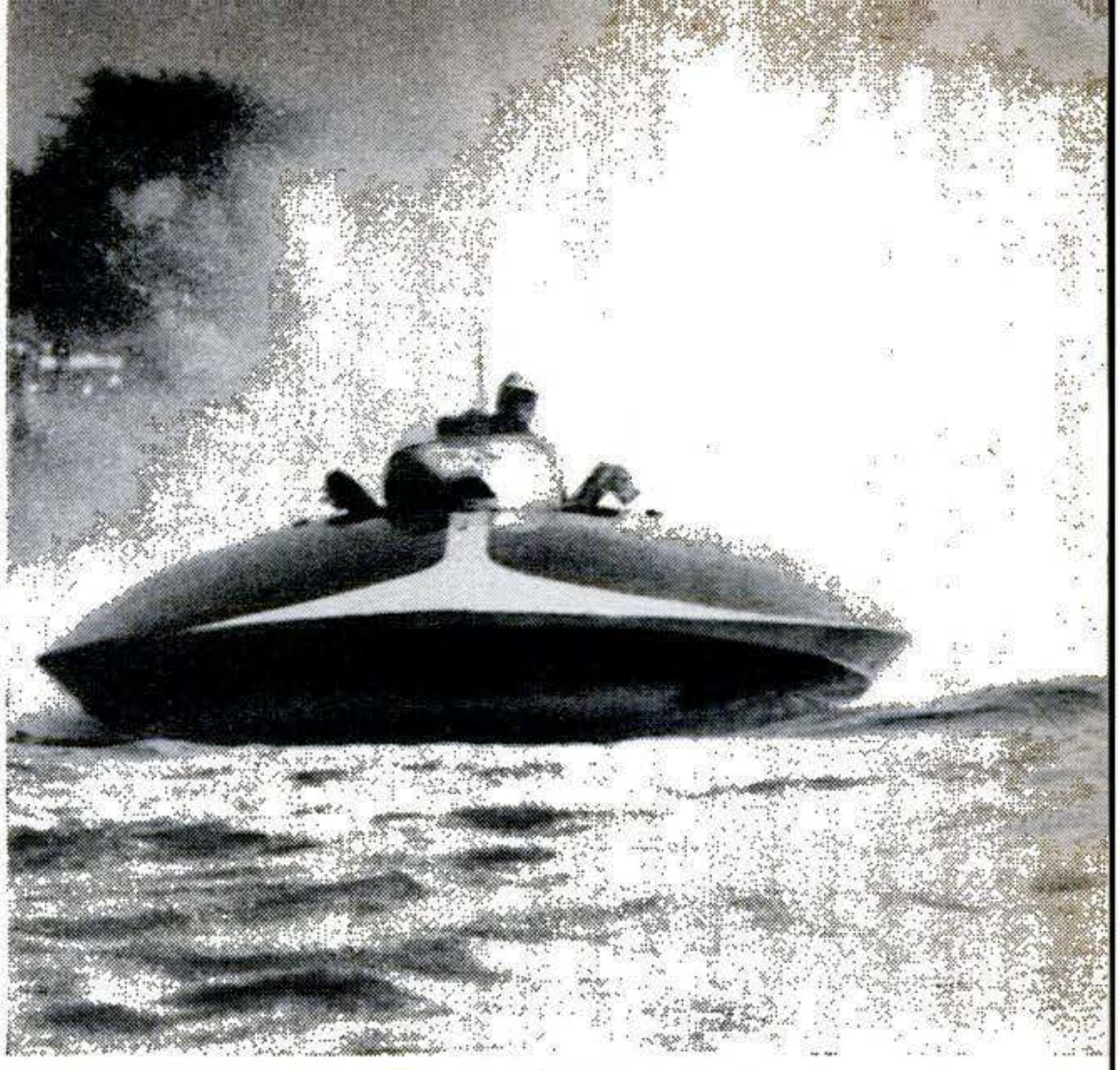


9 out of 10 race car winners use Champion spark plugs . . .



9 out of 10 powerboat winners use Champions . . .

More aircraft use Champions than any other spark plug . . .

Over twice as many car makers specify Champion spark plugs.

Q. Why do the experts in field after field where power is vital choose Champion spark plugs?

A. Because they know they can depend on Champions to deliver every bit of performance from every drop of gas. Your car will perform better, too (and save money on gasoline) with new Champions. Put in a set every 10,000 miles!

Worn spark plugs waste lots of gas— so check your plugs every 5,000 miles!

CHAMPION

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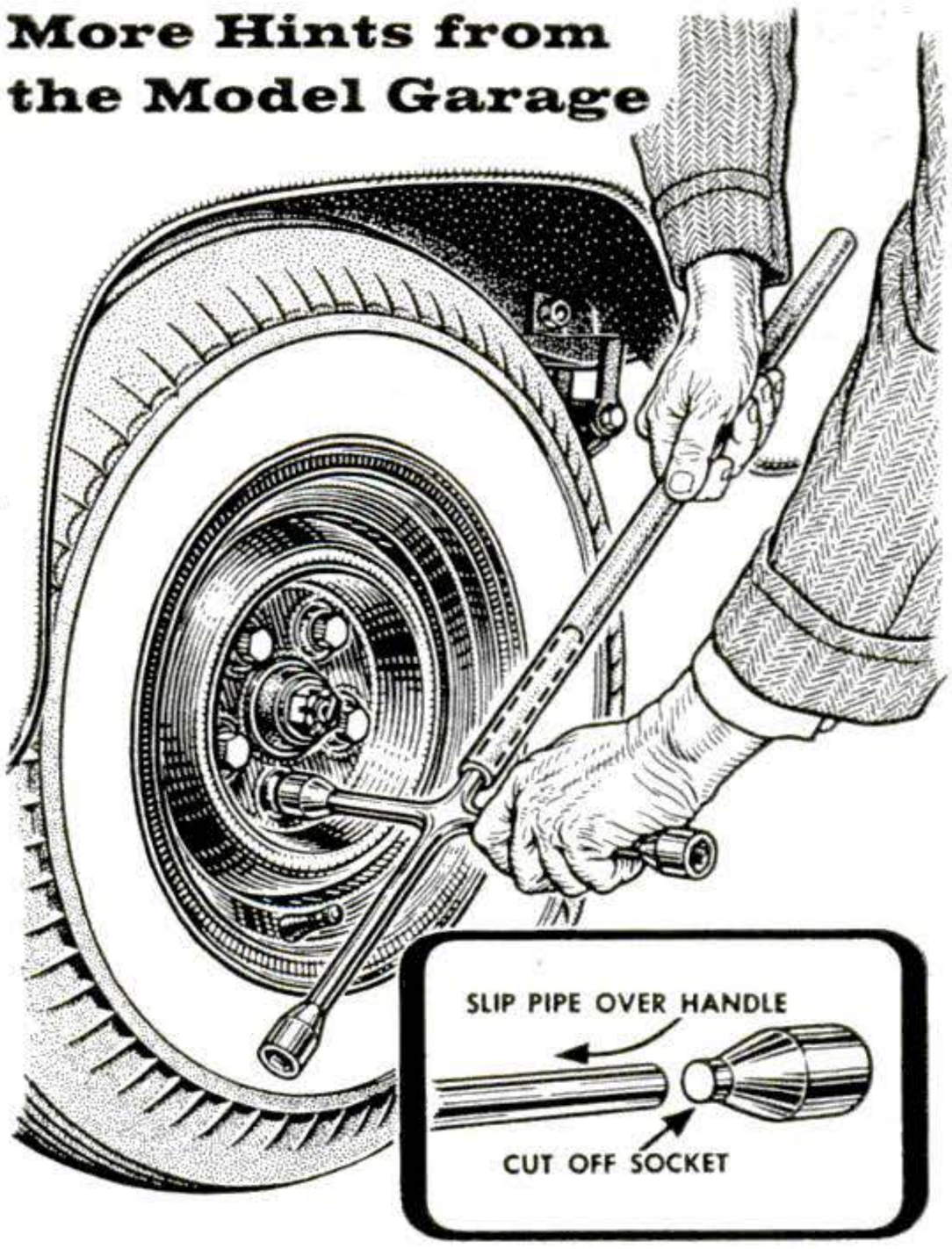
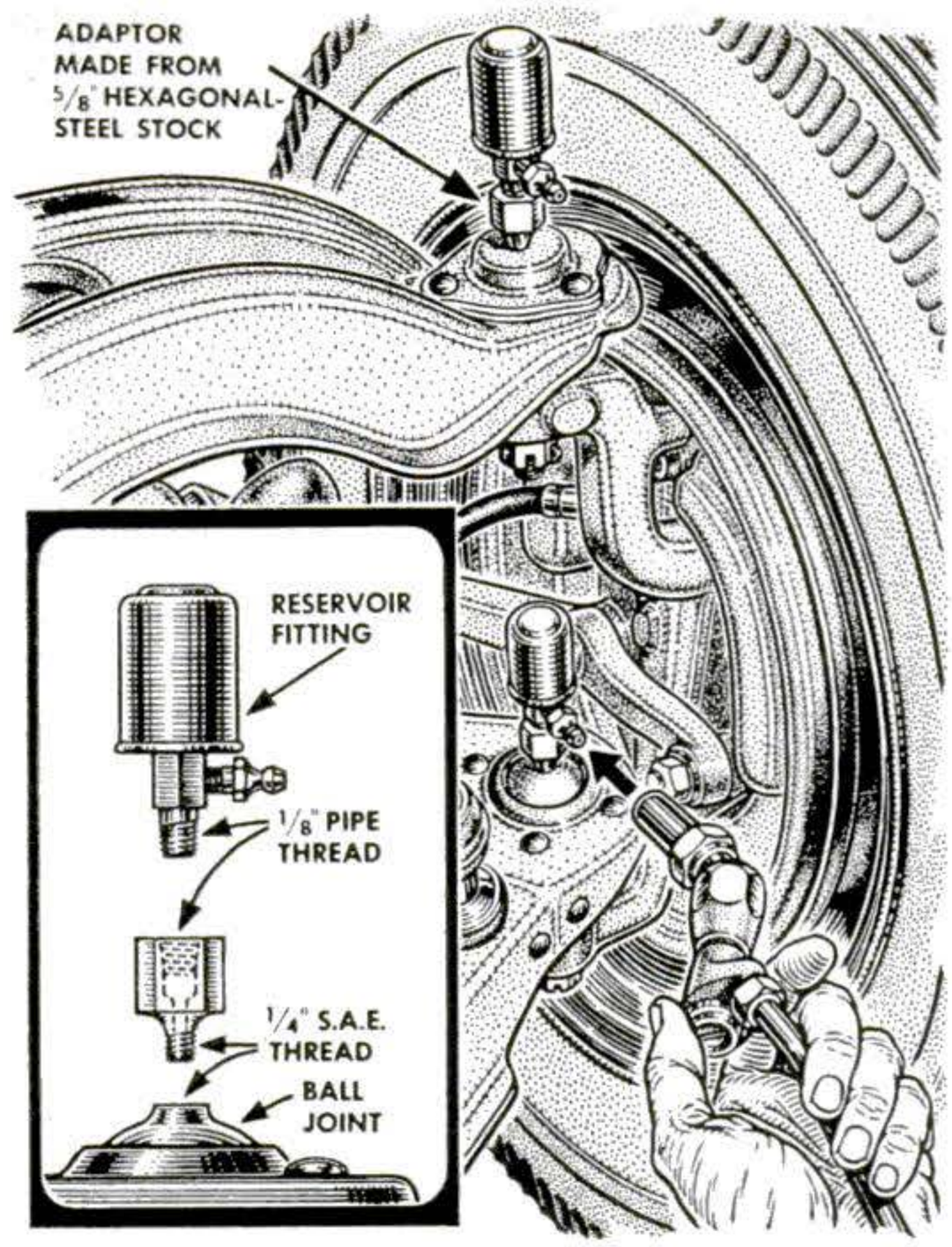
More Hints from the Model Garage



Loosening wheel lugs is easy if you have leverage. Cut off the lug-wrench socket next to the one that fits your car. Then slip a two-foot pipe extension over the shaft. Women will appreciate this if they ever have to change a tire.



Ball joints won't run dry when greased continuously by these reservoir fittings. Grease pumped into the spring-loaded fittings is fed into the bearings as they require it. Your car will always run as if it just came off the lube rack.

"Tack" notes to the dash panel with a small magnet—the type sold in stationery stores for kitchen use. They're strong enough to hold without sliding. You can use them to hold addresses, maps, or reminders of errands to be done.

Clean the sump, too, when changing paper air-cleaner elements. Dirt, trapped in the sump after being stopped by the filter, may find its way into the carburetor. Best practice is to remove the whole assembly before taking out the filter.

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"I 'built' my Chevy as a trailbreaker."

"That's my office there in the picture, you might say. I'm a conservation officer, and I spend most of my time patrolling my beat—four hundred square miles of wilderness, with darned few miles of road in it. Takes a real man-sized car to haul me and my equipment around. I talked it over with a Chevrolet dealer a while back, and when he pulled out that tremendous list of options—well, here's what I'm driving now:

"A Nomad station wagon, as you can see. Four doors, six passengers, plenty of space for gear—a beauty, isn't she? Under the hood, there's that 230-horse Super Turbo-Fire V8*. I teamed it with the standard three-speed transmission. You just don't find a tougher pair than that, or one that's quicker to answer. I wouldn't pass up Positraction,* of course, for pulling through the gumbo that comes up around here after a rain. Heavy-duty clutch* and rear coil springs,* seat belts* and a compass* finished this baby off fine.

"This, friend, is all car, and it won't quit no matter how hard I push it. And the best part of it is it's all mine, with all the things I want in a car."

You can do your own "building," you know, with Chevy's long-as-your-arm list of options. Sports car, family car, luxury car—you name it, you can create it. Right now, we'd suggest a trip to your Chevrolet dealer's. . . . Chevrolet Division of General Motors, Detroit 2, Michigan. **Optional at extra cost.*

Whatever sort of car you'd like your car to be, there's a Chevy package that'll fit you like a glove. Seven perky engines . . . five transmissions . . . special cams . . . solid or hydraulic valve lifters . . . dozens of heavy-duty and comfort and convenience features . . . you've got some really pleasant choosing ahead of you!

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"Hold on, Tony!" yelled Gus as the little man ran in front of the ***V-8 like a one-man roadblock.***

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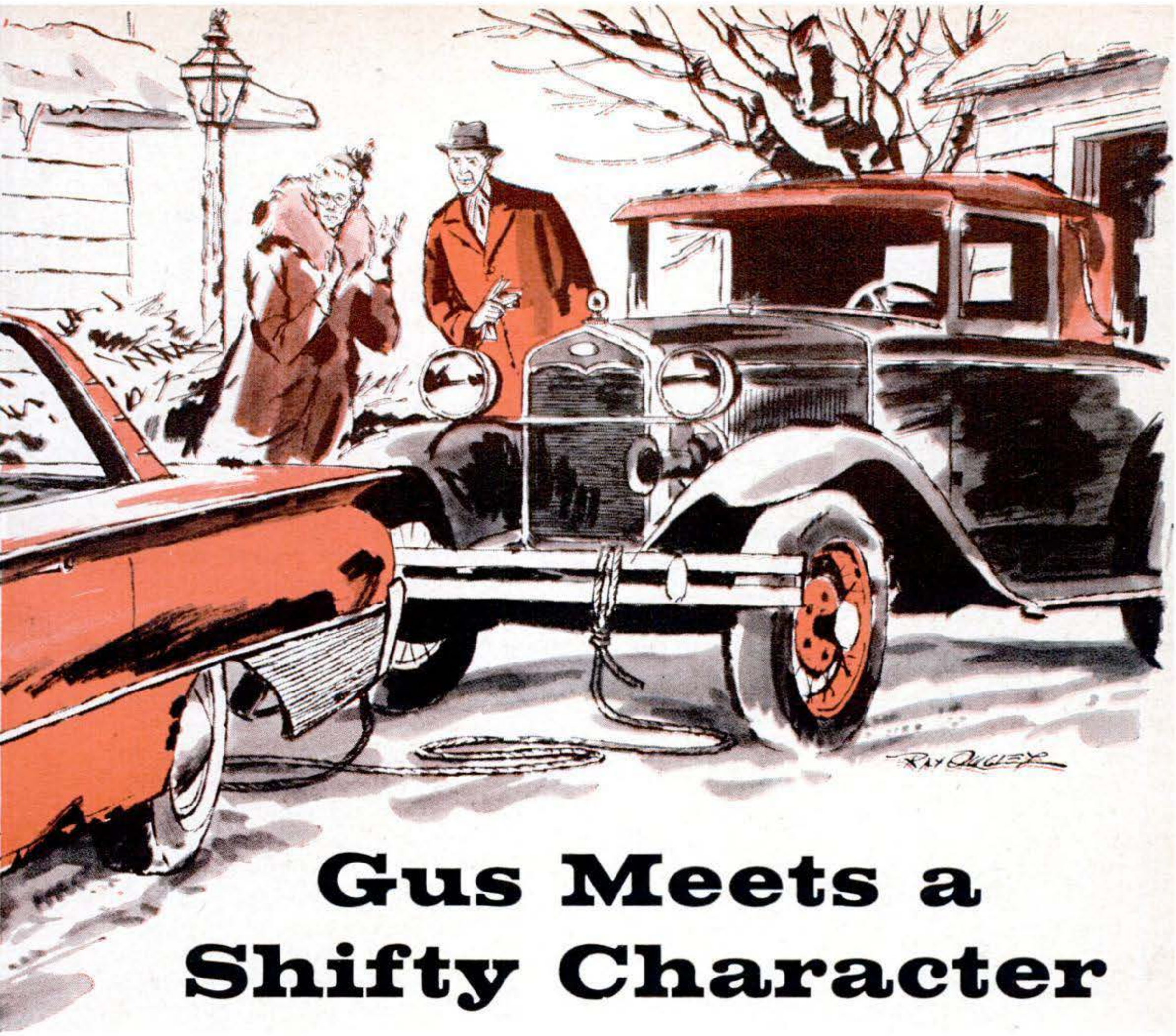

Gus Meets a Shifty Character

By Martin Bunn

BUSY one freezing morning in the Model Garage, Gus and Stan raised their heads as a familiar chugging drew near.

"Mrs. Holden's Model A! But she'd never be driving in this weather."

Gus opened the overhead door and looked out. "It's her car all right."

Prim with black paint and nickel-plated radiator, a snow-capped little Ford cabriolet moved up the concrete apron, only to cough and sigh to a stop half in, half outside the shop. A dark, curly-headed little man scrambled out.

"Sorry, Gus. She just made it." Despite the chill, sweat rolled from the black locks under his cap.

"Okay, Tony," soothed Gus. "Let's just push it in the shop."

Once the Model A was inside, Tony shrugged. "We got a mystery, Gus. She starts fine—right away. But one block, maybe two, and the engine quits . . . like now."

"I bet Mrs. Holden went visiting yesterday," said Gus. "When it started to sleet and snow, she left the car overnight and sent you for it this morning. Am I right, Tony?"

He knew that Mrs. Holden, an elderly widow still driving the car her husband had bought 30 years before, never turned a wheel on storm-slick streets.

"That's right," agreed Tony. "I'm glad to do it. She's a good customer for my gardening. Besides, I don't like to see this fine car standing on the street."

"You go in my office and pour yourself a cup of coffee," Gus said. "We'll fix it."

As Gus continued thawing a frozen gas

CONTINUED

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line in another car, Stan sauntered up.

"Want me to check the Ford?"

"No," answered Gus. "Just clean that ice clump off the cowl."

While Tony watched, cup in hand, Stan carefully freed the frozen mass, revealing the gas cap under it.

"Okay, Boss. Blow out the gas line?"

"No. With a frozen line, Tony wouldn't have got this far, even in easy stages. Blow out the cap vent."

Stan removed the notched gas cap. He found no vent in the top. The under rim was packed with icy snow. Gouging it out, he found a small vent hole there.

"No wonder it kept stalling," he reported. "This was blocked solid. Air couldn't get in, gas couldn't flow out."

Gus nodded over his own job. "Until the engine stalled. Then enough air would leak in to let the carburetor fill up."

Stan wiped and replaced the cap. "Okay, Tony. Say, you and Mrs. Holden sure keep this car in fine shape."

Tony stroked the hood lovingly. "When I land here, a boy from Italy, first car I see is a new one like this. Just what I want. Now you can't buy this kind. But I take good care of the car for Mrs. Holden. Some day she'll sell her to me."

"He sure loves that car," said Stan as the little Italian drove off.

"Lots of people loved the Model A," remarked Gus. "I think Tony will get that one soon. Mrs. Holden told me she isn't renewing her license."

BACK to the day's quota of jobs, Gus and his helper almost forgot the episode. But late that afternoon they were alerted by a squeal of hasty brakes. The pickup Tony used for gardening jobs slid to a stop; the little man tore open the door to the shop and ran in.

"Please, Gus! You gotta come. This time it's real big trouble that I've got."

"Relax, Tony. Mrs. Holden won't drive the car with snow on the ground."

"You don't understand, Gus. Come on, I'll tell you while we go!" wailed Tony—literally pulling Gus along.

Once out of traffic, the little gardener exploded into speech. "It's the nephew, Grover. He's only come to see her once, twice, before. Right away when he sees the car, he wants her. Mrs. Holden says no, she'll sell her to me.

"Today, that Grover, he comes in after I drive the car home and go to another job. When I come back to clean out the cellar, Mrs. Holden is upset. Grover, he looked at the car in the garage and says the transmission is busted, she'll never run again.

"So Mrs. Holden tells him how I just drove the car home and she must be all right. He says he'll show her how I am the guy who busted it, and he shows her. Gus, it's awful. But I didn't do it!"

Before Gus could speak, Tony swung into a long curving drive. The Model A stood near the garage. In front of the old car, and joined to it by a towline, was a modern V-8 hardtop. Randy Smith, a young man Gus knew slightly, sat at the wheel of the modern car.

Tony pulled up hard, jumped out, and ran toward Mrs. Holden and a sleek, too-well-dressed stranger standing with her.

"Hold on, Tony!" yelled Gus, fearful that the excited little man would explode into action. But Tony only ran in front of the V-8, taking the stance of a one-man roadblock.

"Tony told me about your trouble," said Gus on approaching Mrs. Holden. "I came to see if I could help."

"I'm afraid not," she said heavily, for the first time looking all of her 75 years. "Grover is sure the gears are stripped. Since spare parts cannot be had for so old a car, I may as well let it go. He

Where'd it come from?

MILE: Along the roads they built, the Romans reckoned distances in "milia"—each a thousand paces long. The "passus" was the amount of ground one foot could cover in a double step—about five feet. Fifteen hundred years later Queen Elizabeth increased the mile to 5,280 feet as a favor to surveyors. Their common measure was the furlong: The new mile would be exactly eight furlongs.

CONTINUED

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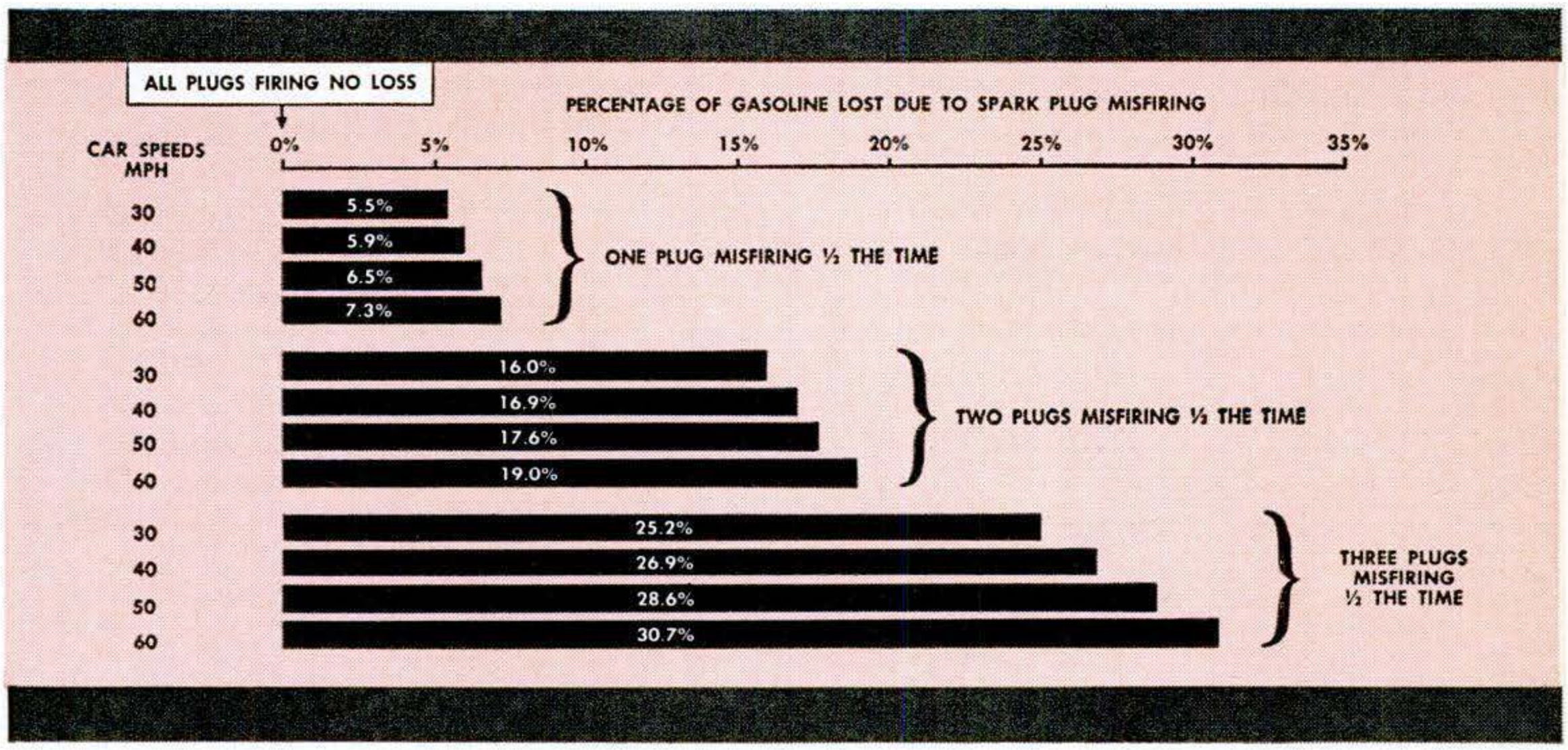
Look how much you lose when Spark Plugs misfire!

All spark plugs tend to misfire intermittently as they wear, and modern high horsepower engines make it difficult to tell when such misfiring occurs. But as the chart below shows, spark plugs that fire only part of the time waste gas by the gallon. For example, if your car gets 16 miles per gallon at 60 miles per hour, one misfiring spark plug can drop your mileage 7.3% to 14.8 – two can drop it 19% to 13 – three can drop it to 30.7% to less than 12. You lose mileage at all speeds, and the higher the speed, the greater the loss.



To get the best mileage from your car, replace your spark plugs at least every 10,000 miles with new ACs. AC Fire-Ring Spark Plugs will pay for themselves through the improved mileage you'll get. ACs have such mileage-producing features as exclusive leakproof conducting seal center electrode bond for uniform heat range, and superior Buttress Top insulator for greatest resistance to electrical flashover leakage. These plus many other advancements have kept AC in the forefront of spark plug development for 52 years. See your dealer, ask for ACs — and save.

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They must be the best!

AC Fire-Ring Spark Plugs

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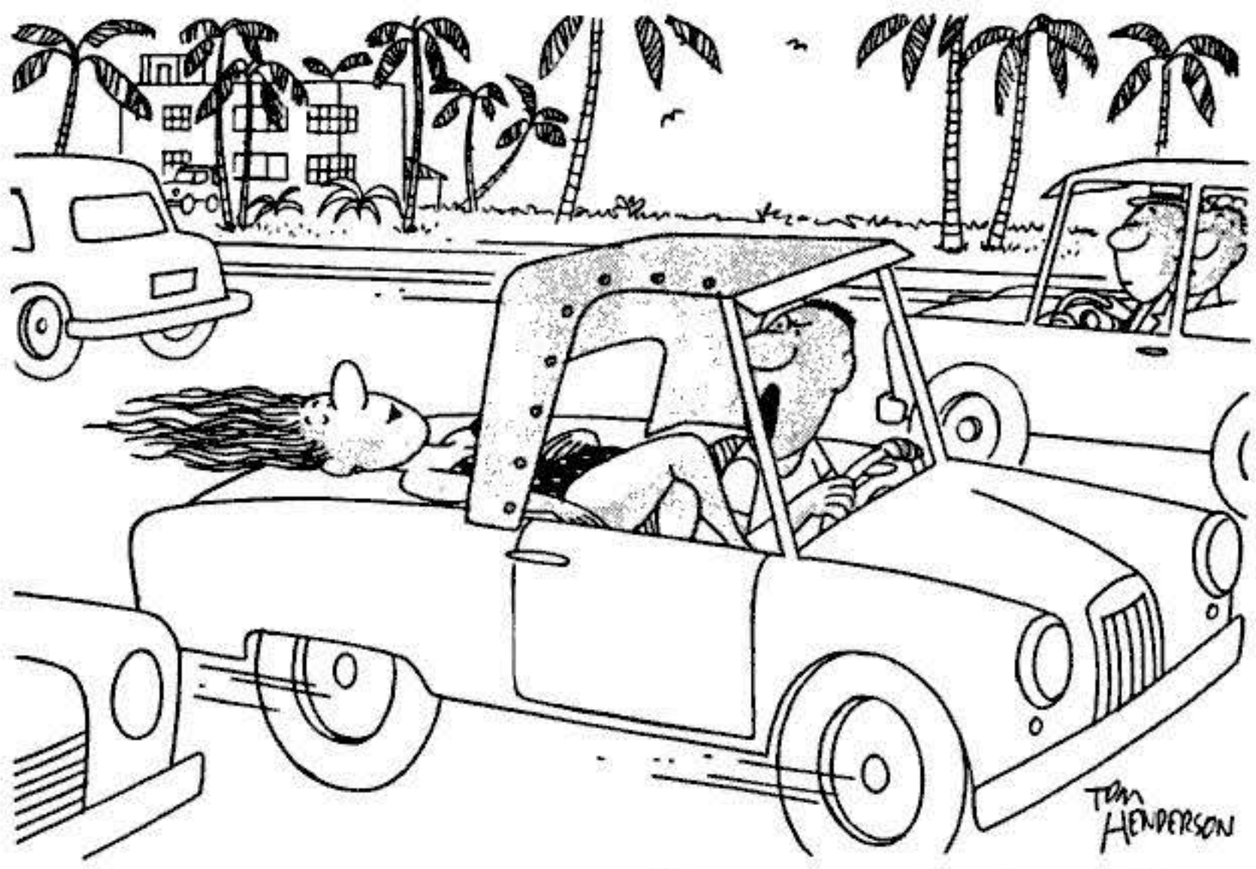
knows some rich men who collect old automobiles, and could afford to have parts specially made."

Her voice trembled a little. "I know how much Tony wanted the car. But it would be no kindness to give him trouble and expense he cannot afford."

"May I look at it?" asked Gus.

She nodded listlessly, but the young man shook his head. "Haven't time, Dad. I've got a long tow ahead. Want to start before it gets dark."

He jumped into the Model A and slammed the door, but not before Gus had looked into the car. What he saw wasn't reassuring. The shift lever sprouting from the middle of the floor stood far over to the right and against the dash, as though broken or bent inside the gearbox.



"Harriet! Can't you wait till we get to the beach?"

Gus nipped around the car, opened the other door, and got in. "Don't rush off," he said mildly. "I just may be able to fix that."

Before young Grover could protest, he grasped the lever, lifted it straight and let it drop neatly into normal neutral position.

"You can drive it again now, Mrs. Holden," announced Gus.

"She's through with this car," snapped the young man. "I have the registration right here."

He flipped a paper out of his pocket and waved it. But a slender gloved hand snatched it from his hand.

"You hadn't paid for it, Grover," said Mrs. Holden. "And now Mr. Wilson has raised some questions in my mind."

"Okay, so I wanted to make a few bucks. I know somebody who wants an old crate like this. Where could you sell it, Auntie? I'll pay you later."

"Grover, did you fake that damage?"

"Me? Certainly not. I think your gardener did it to get the car cheap."

Gus's tolerance snapped. "That does it! Mrs. Holden, suppose you ask Randy Smith how far he agreed to tow the car."

As the old lady walked to the V-8, Gus took the Model A's ignition key from the lock and stepped out. He had the towline unhitched by the time Mrs. Holden came back, fire in her eyes.

"He was hired to tow it only as far as the state highway. So my nephew expected to drive it from there. Grover, you are a fraud."

The sleek young man got into the other car. He seemed to be arguing with the driver as it sped off.

"He'll have to pay for something he never got," chuckled Gus, giving Mrs. Holden the car key. "Guess I'll need a ride to town."

"I am very grateful," said Mrs. Holden. "Tony, take him in your car."

"Sure," Tony said. But as he headed for the pickup, a small hand thrust a key and a paper toward him.

"Your *car,* not your truck, Tony."

The little man stared at the key. Then his eyes crinkled and a hitherto invisible Adam's apple bobbed in his throat.

"LUCKY for me you could fix it so easy," said Tony as he drove off.

"Oh, that spavined shift lever is an old gag," Gus explained. "Young Grover must have heard about it from antique-car collectors. Pull the lever up out of its socket, and you can put it in that crazy position. But it will snap right back. We used to play that nasty little trick on each of our friends when he got his first Model A, then swear him to silence to keep the gag alive."

"Lucky for me that you remember so good, Gus."

"How could I forget?" asked Gus with a grin. "I learned it the hard way—right after I got *my* first Model A."

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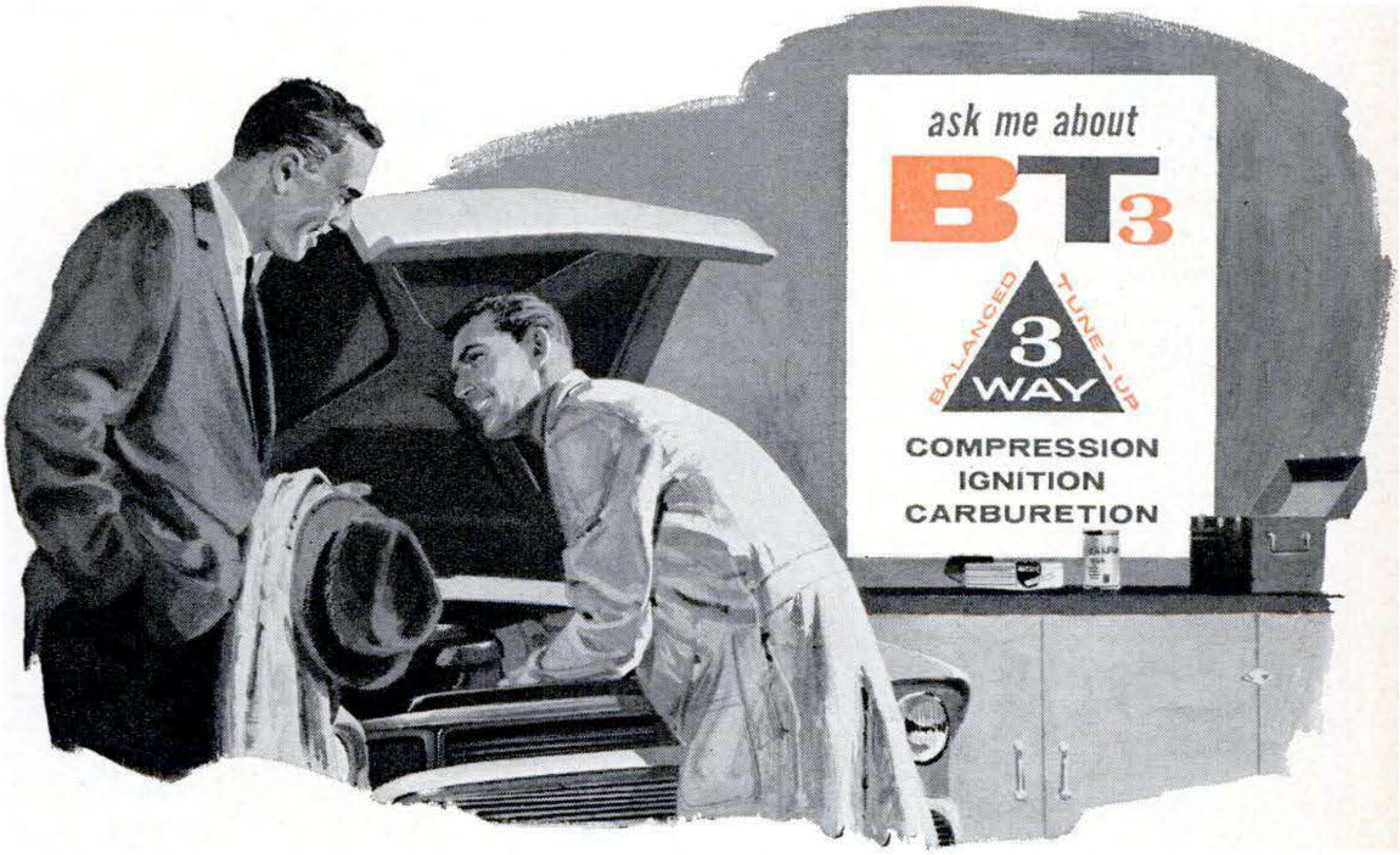
NEW BT3 ENDS TUNE-UP GUESSWORK!



NEW TUNE-UP CONCEPT BALANCES CARBURETION, COMPRESSION AND IGNITION TO RESTORE *NEW CAR POWER!*

Maintain the new car power, performance and economy that was designed into your GM car. Get a BT-3 tune-up . . . the *balanced* tune-up, three ways.

With this new concept, your compression, ignition and carburetion are checked, adjusted and restored to new car condition. Every replacement part is factory approved. For example, all carburetor parts are genuine parts for Rochester-GM Carburetors . . . original equipment on more new cars than any other carburetor. And the whole step-by-step, scientific procedure of BT-3 is factory recommended.

Stop wherever you see the BT-3 sign, and enjoy the new car performance that only a balanced tune-up can give. Or if qualified service is your business, contact your nearby UMS distributor to learn how to give BT-3 to your customers.

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America's number one original equipment carburetors

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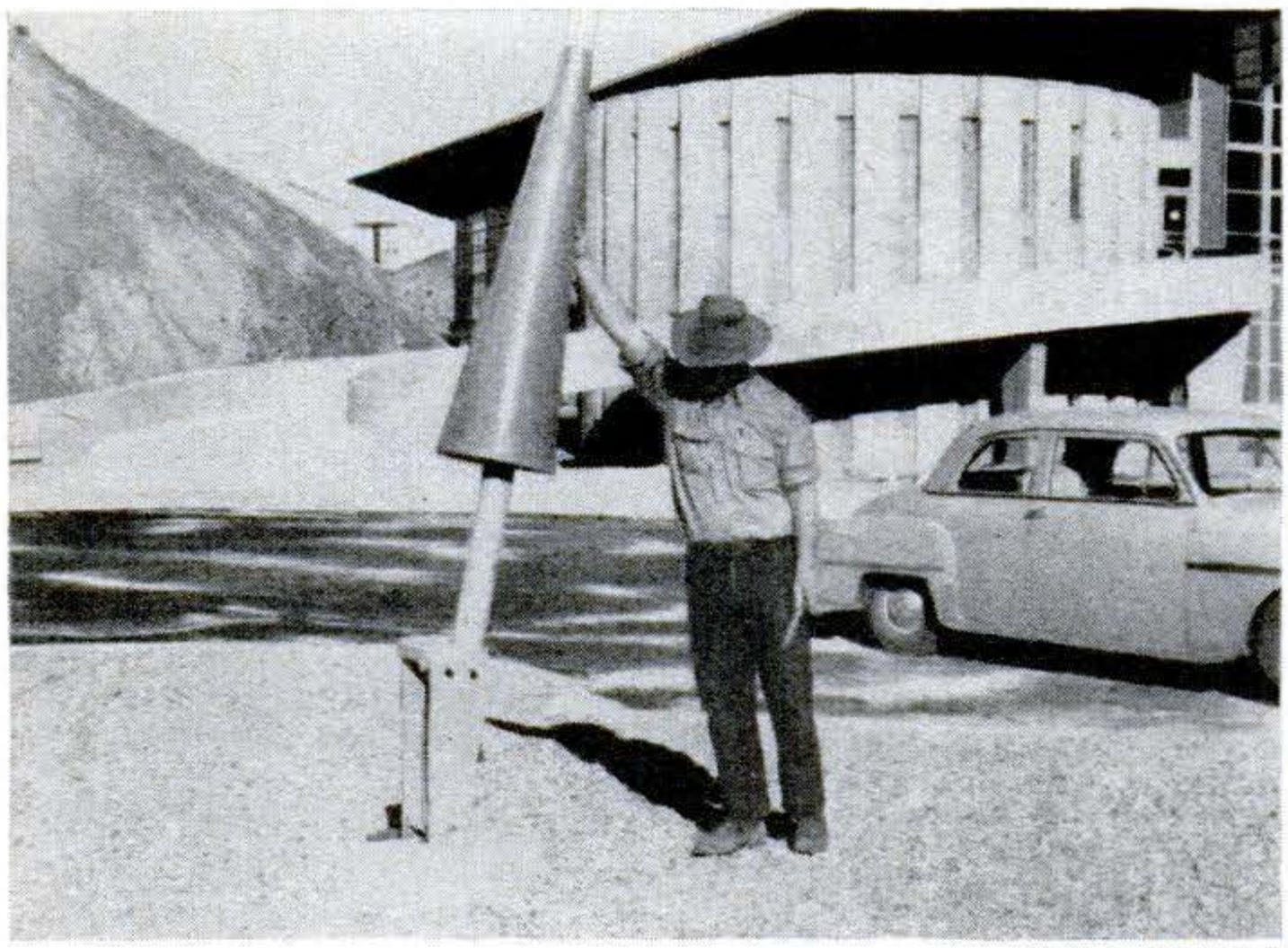
Short Cuts and Tips

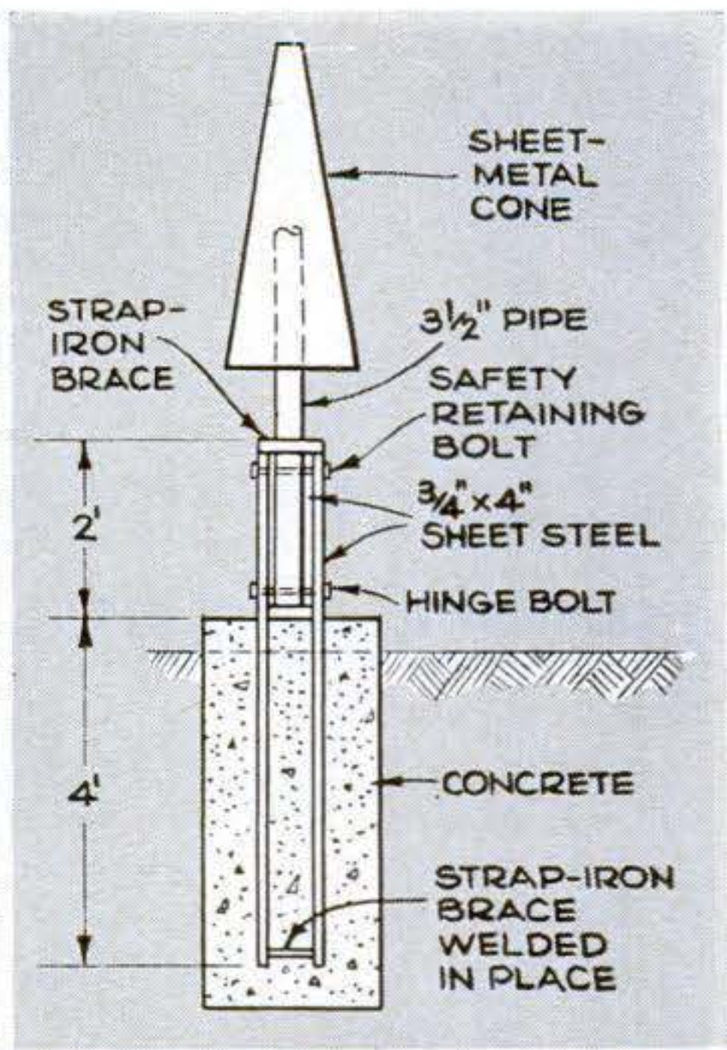
FROM PS READERS

Adjustable Workshop Light

THE droplight over a workbench can be slanted in a special direction this way. Bend a hook at each end of a length of wire. Attach one hook to the edge of the shade and the other one around the electric cord.

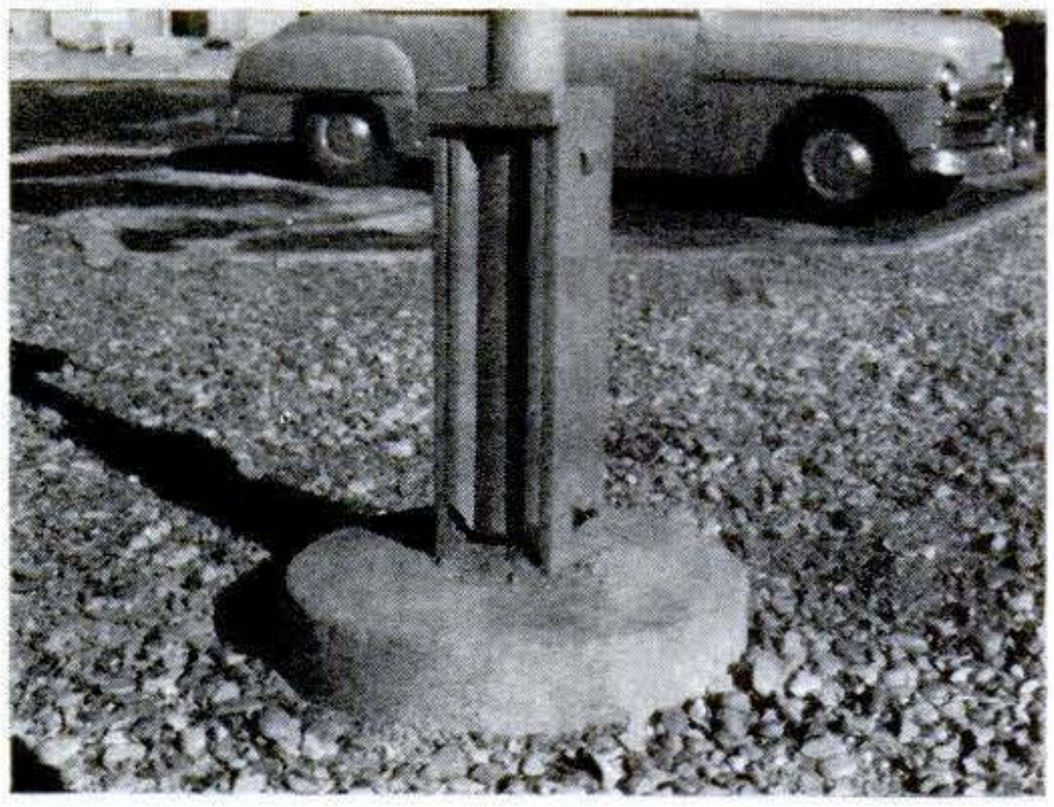
Sliding the hook around the shade edge changes the position of the light; varying wire length changes the angle. Tape the cord hook to avoid chance of a short. —*F. Murray, Chicago.*





Hinged Mount for Flagpole

TALL flagpoles need steeplejack skill for painting and changing lanyards. If you have this problem, here's a hinged flagpole mount devised by George W. MacKnight, National Park Service foreman at Dinosaur National Monument, Utah. He built the mount as shown in the drawing, and covered it with a sliding sheet-metal cone base. When maintenance time comes, he raises the cone, removes the retaining bolt, and lets the pole swing down on the hinged bracket.



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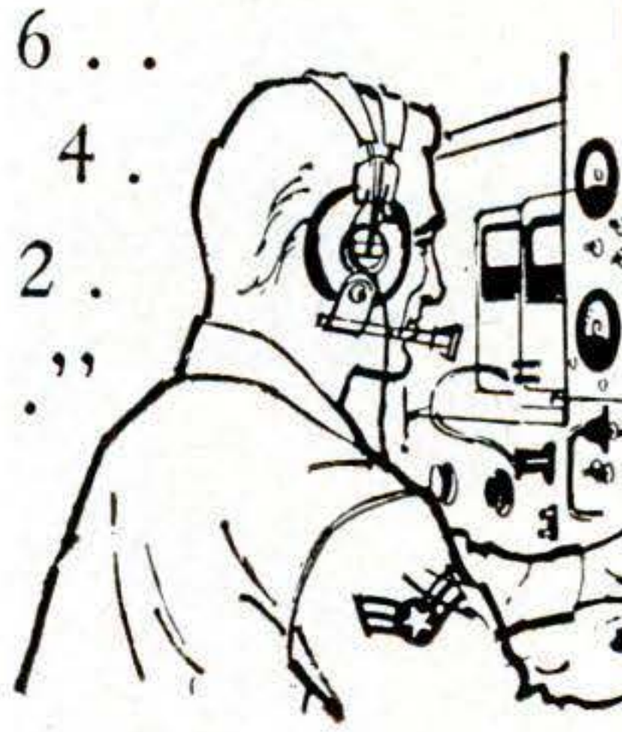
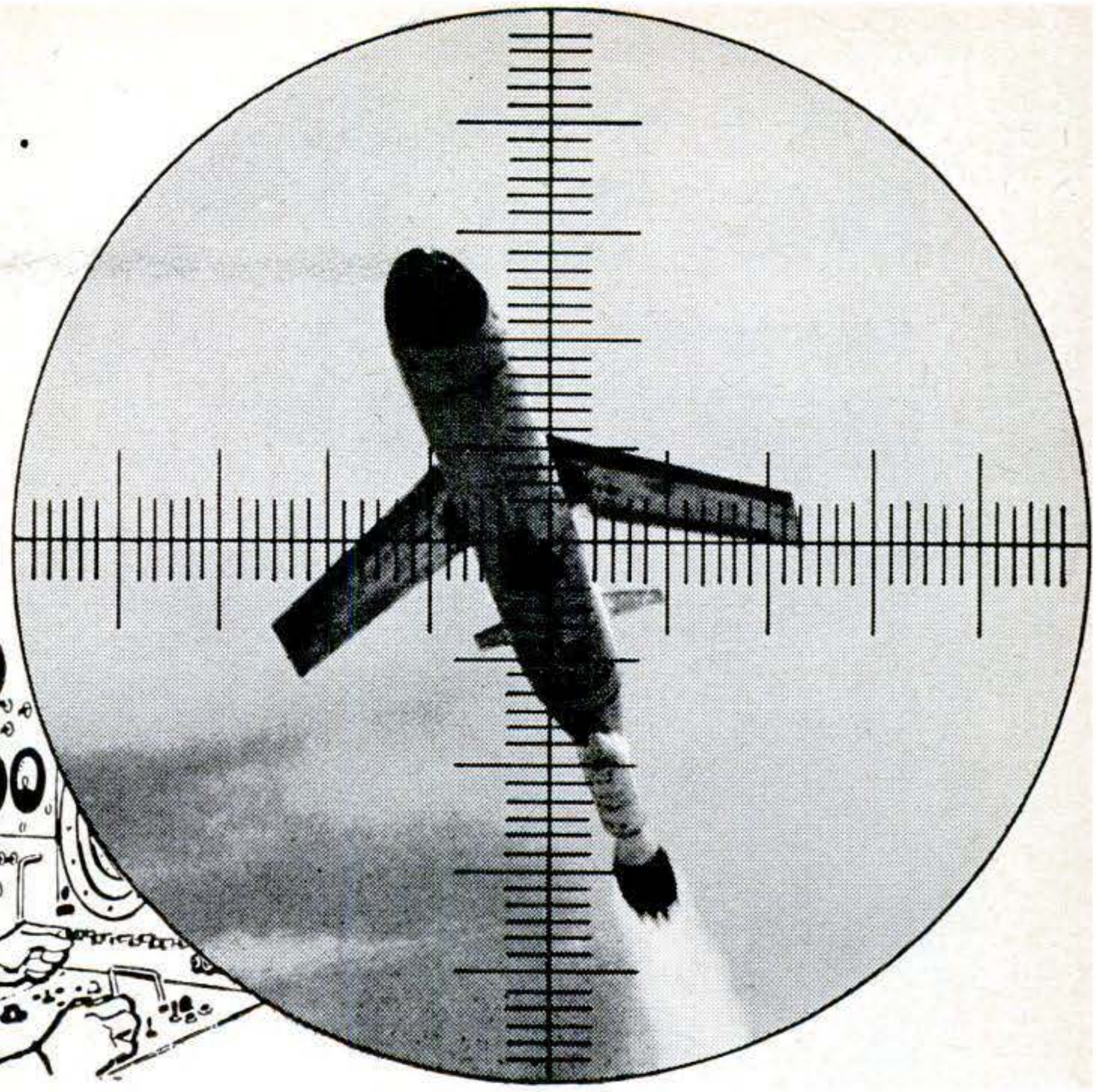
"All personnel . .
clear the firing area . . .
stand by for
countdown . . .
minus 10 . . .
. . 9 . . . 8 . . . .
7 . . 6 . .
. 5 . . 4 .
3 . . . 2 .
. . 1 . ."





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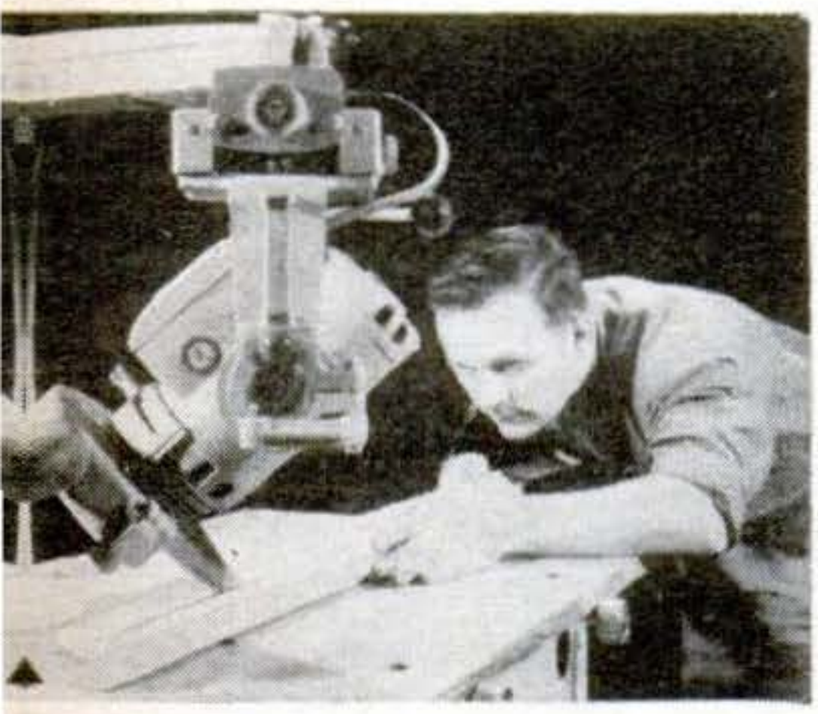
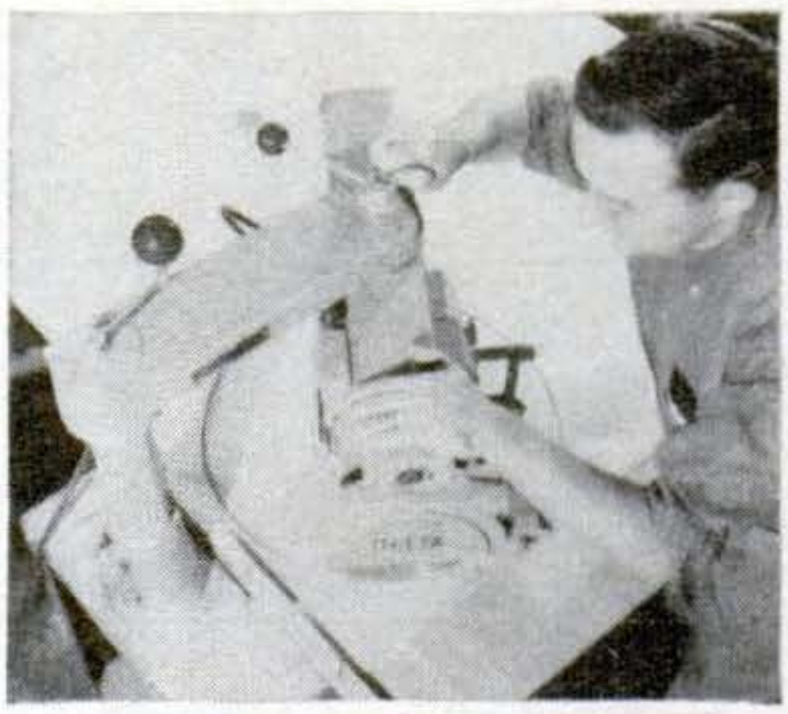
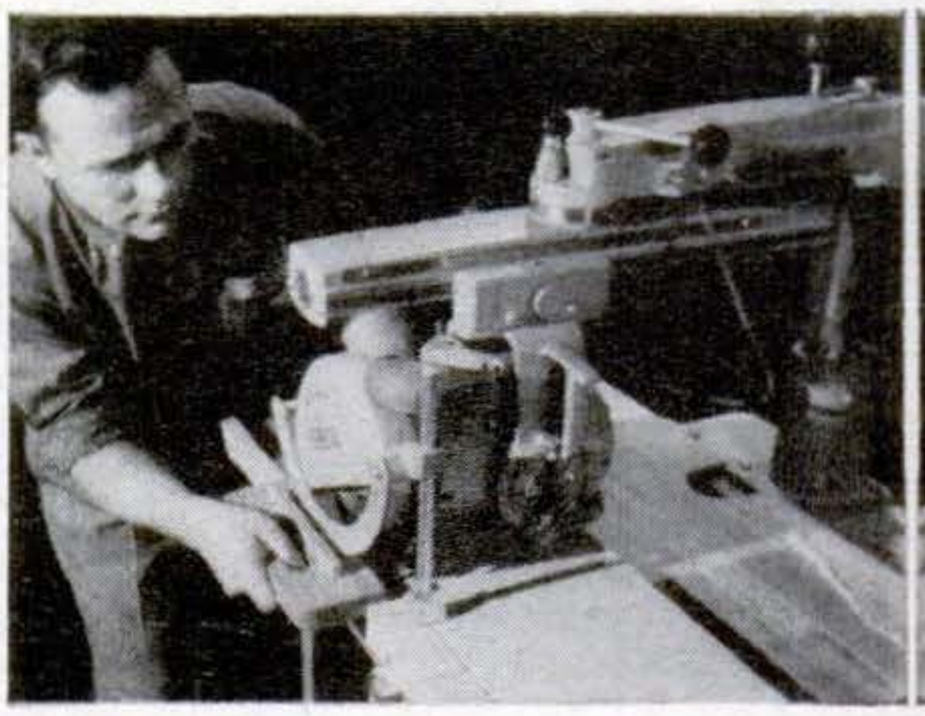
You can do more with DELTA



CUTTING MOULDINGS such as this extra large cove moulding is easily done with the regular blade. By simply adding the moulding cutter-head you can cut an endless variety of shapes.



CIRCLE CUTTING is not limited to only one diameter—another advantage of exclusive "Turret Arm" action. You'll really appreciate how easy it is to do this unusual operation with complete accuracy.



SAFE RIPPING of narrow strips is assured because you can lock the fence quickly in the "up front" position. Handy push grip provides smooth, steady feeding action from start to finish.

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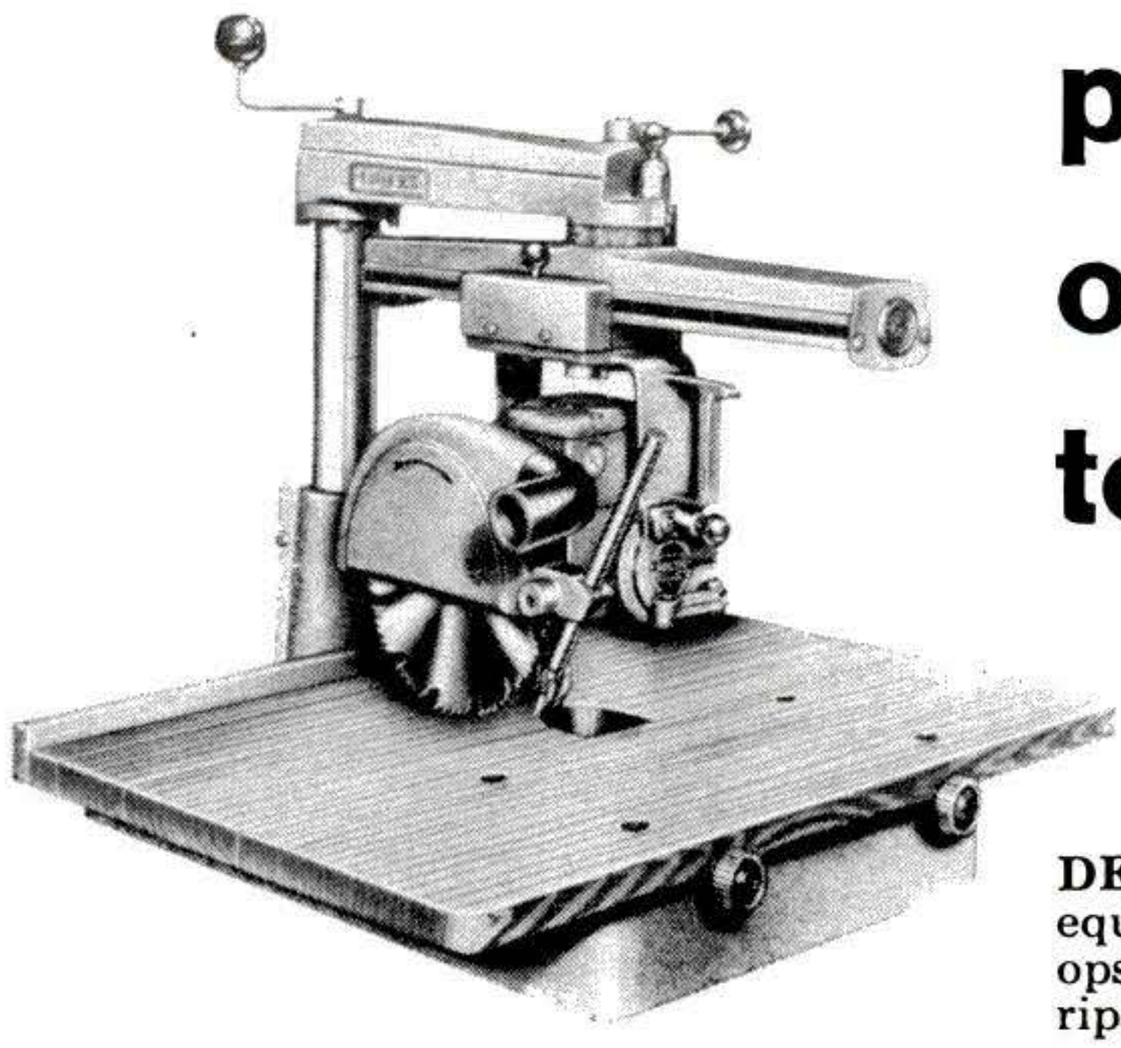
"Super 900" Radial Saw



puts more of your skill to work

DELTA "SUPER 900" RADIAL SAW—equipped with powerful motor that develops up to 2 H.P.; cuts 2½" thick stock, rips up to 24" wide.

Here's a workshop workhorse that tackles the toughest jobs you've got—and delivers perfection every time! This rugged Delta Radial gives you precision that is actually built in, yet is easy to use right from the start. You get all the flexibility that Delta "Turret Arm" action provides. Swing, spin or tilt the head—you'll do dozens of operations conveniently, safely because the cutting tool stays over the table throughout a 360° swivel. With this machine you never have to worry about alignment. Thanks to Delta's exclusive, new "Micro-Set" Miter Stops, you can be sure of perfect 90° and 45° cuts for the *life of the machine.*

There are many other unequalled features you'll recognize. And because you know tools, you'll appreciate the industrial quality that Delta's 31 years of experience build into every power tool. So whether you're adding more versatility or starting a one-tool workshop—get the finest! See the Delta "Super 900" Radial Saw and full range of money-saving accessories when you visit your Delta Dealer (he's listed under "TOOLS" in the Yellow Pages) or see it in action at your leading Department, Hardware or Building Supply Store. Don't wait!

See the world's most complete line of home workshop power tools and accessories—pictured and described in this colorful, FREE Homecraft catalog. Write to: Rockwell Manufacturing Company, Delta Power Tool Division, 504C N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Co. of Canada, Ltd., Guelph, Ont.

DELTA POWER TOOLS

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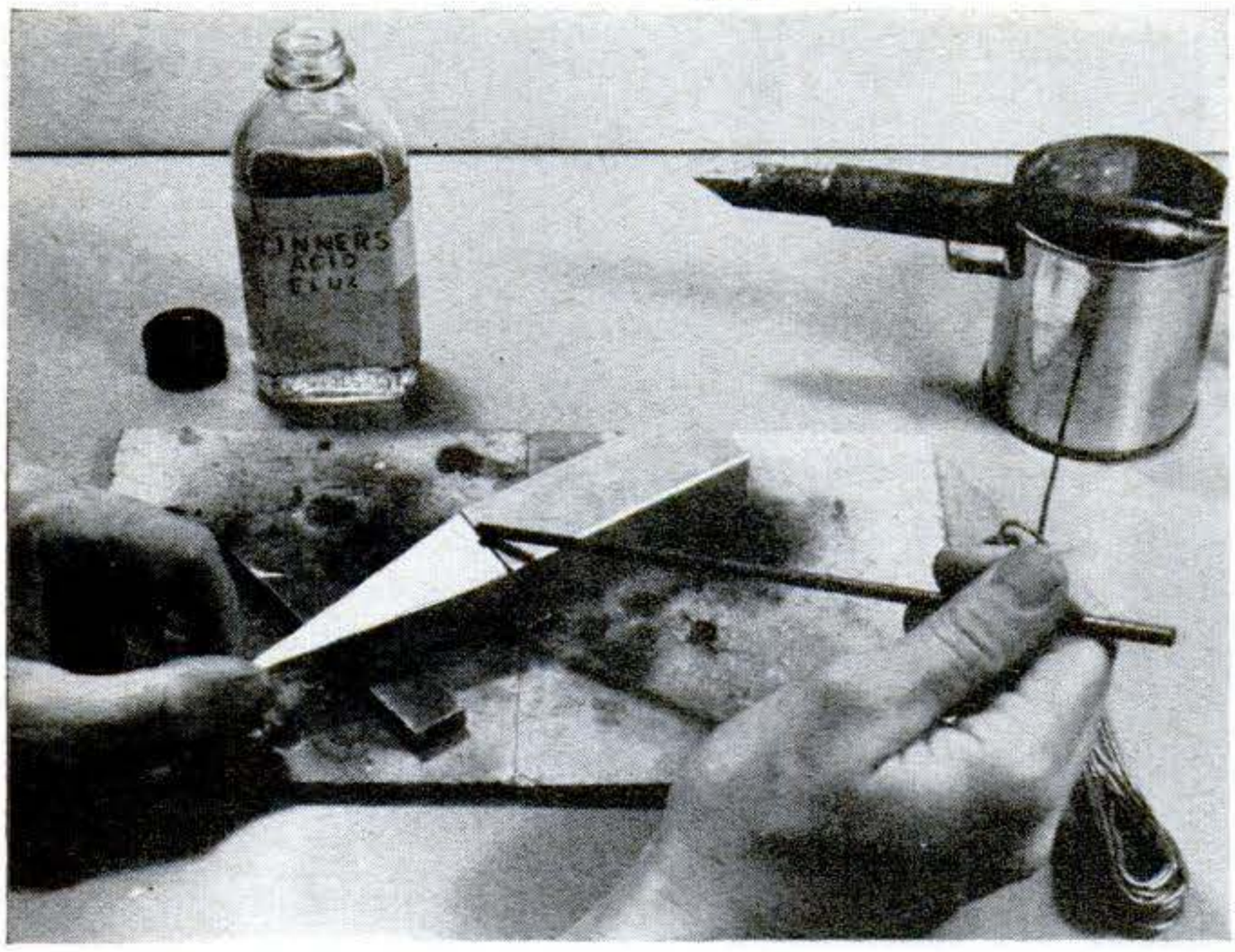
Short Cuts and Tips

FROM PS READERS

Retractable Rods to Hang Clothes

I USED old TV antenna rods to make a clothes-drying rack out of a stairway. The rods slide into holes bored through the stringer under the nose of the treads. When pushed in, the rods are supported by 1" cove molding attached under the steps by ½" brads. Any decorative end-knobs will do. I glued on toothpaste caps.—*G. W. Hummer, Frenchtown, N. J.*



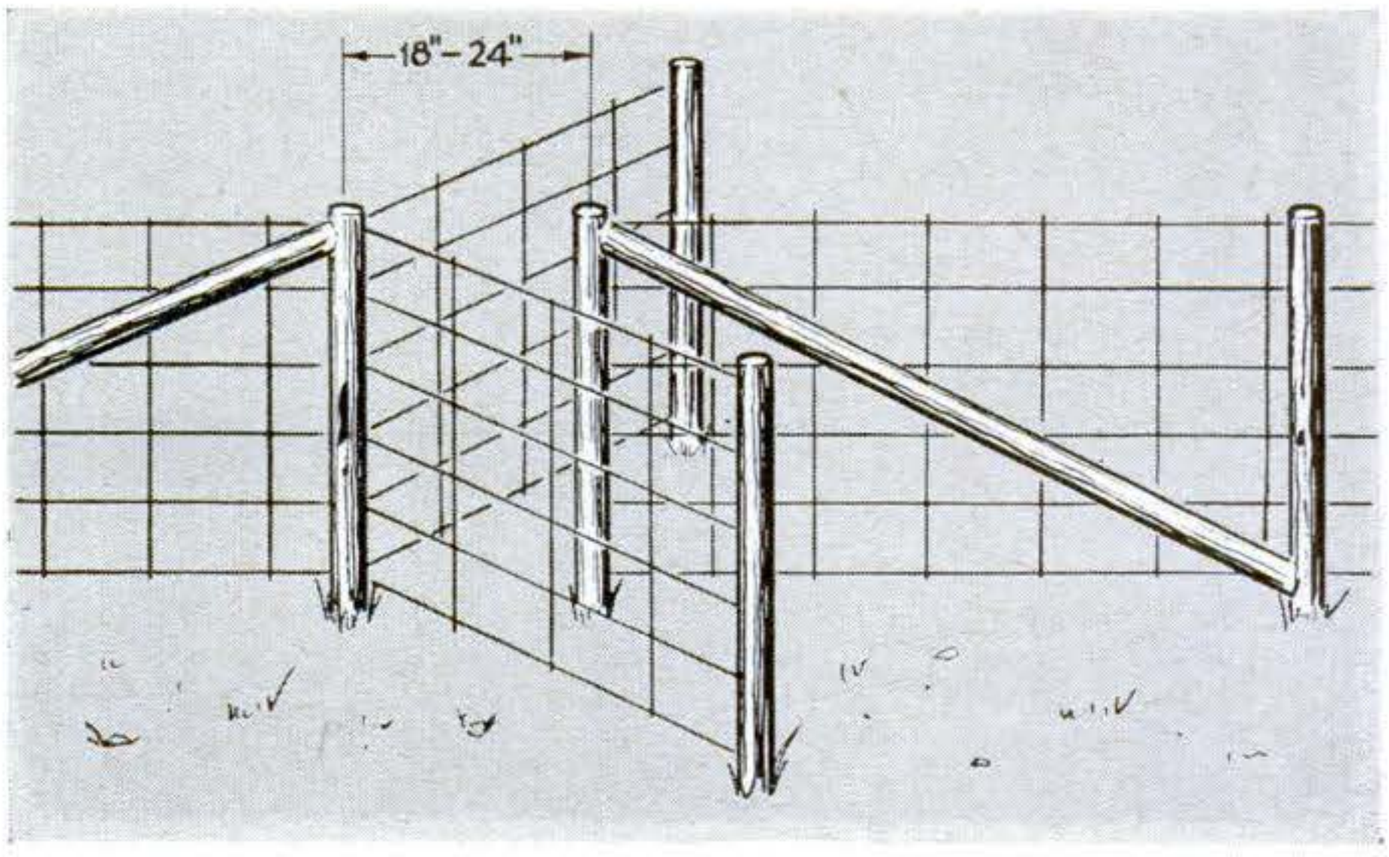
Soldering Aid from Fishing Rod

WHEN using acid flux for soldering, I apply it with a piece of fiber-glass fishing rod. Acid does not affect it, the low heat of the soldering iron does not melt it, and it can be washed and used over again.—*R. Micals, Freehold, N. J.*

▶▶▶PUT newspaper strips between the seal and jamb of your refrigerator door. Close it. If the strips come out readily, the seal is too loose.—*A. Sabo, Detroit.*

People Gap in a Cattle Fence

A WIRE fence with a "Y" opening lets people pass through but keeps large animals corralled. Two extra posts form the notched passageway in the fence run. Make the gap at least 18" wide to accommodate a person, but not more than 24", to prevent cattle from making the sharp turn.—*Victor H. Lamoy, Upper Jay, N. Y.*



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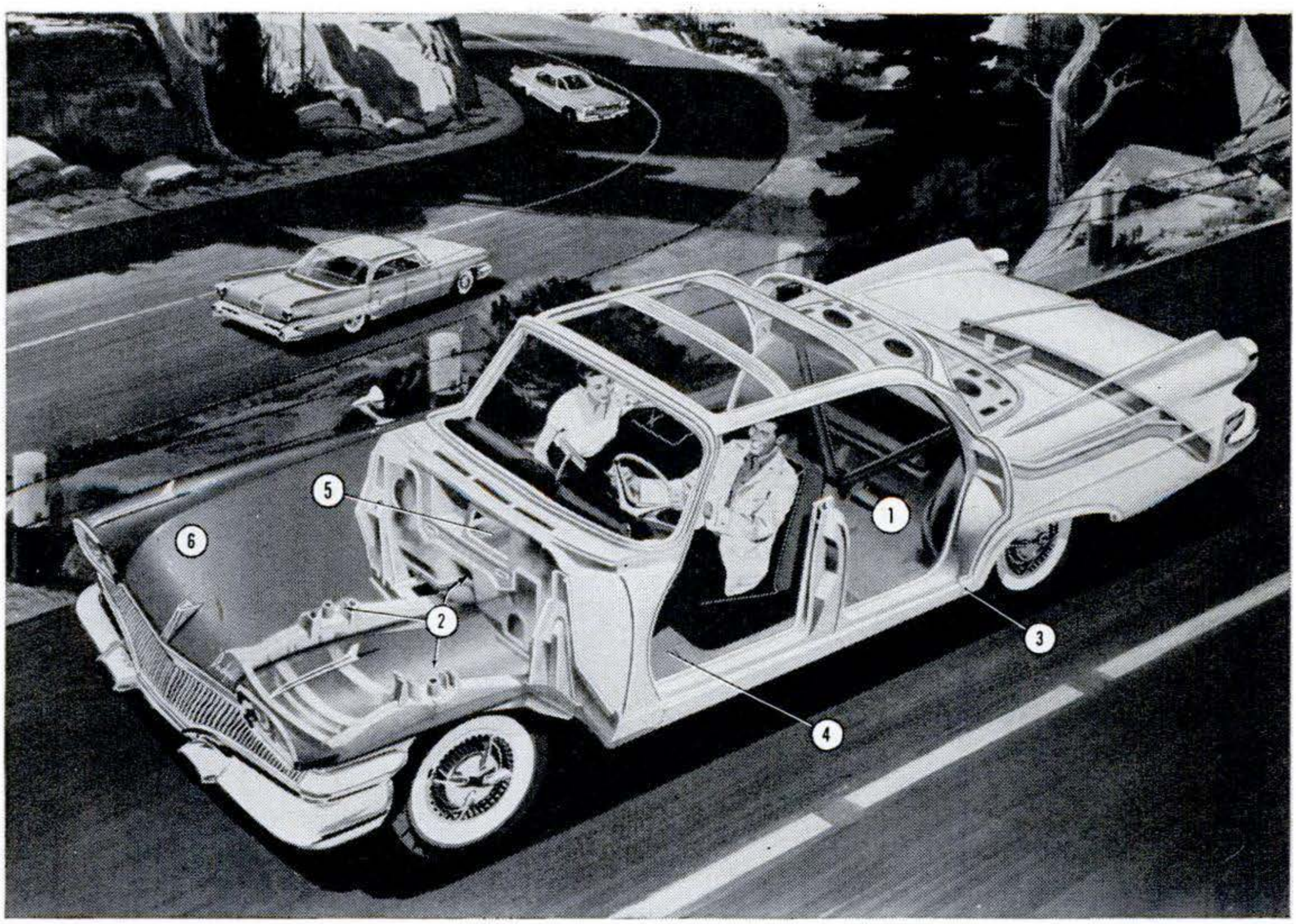
Dodge Dart Is Sound-tight, Weather-tight, Built To Stay Tight!



There are many reasons why Dart rides and feels like it costs hundreds of dollars more than it really does. To build this new kind of low-priced car, Dodge engineers used a striking series of important advances never before available in the low-price field.

1. UNIBODY CONSTRUCTION—Dart eliminates conventional two-piece body-frame construction. It's welded into a single unit with stressed-strength. One-piece construction eliminates body squeaks and rattles. It's far stronger to begin with—and it stays that way.

2. FREE-FLIGHT POWER—New three-point suspension cradles engine in space—actually floats it on supple steel coils and rubber blocks. Sound and vibration are completely isolated from passengers.

3. SPECIAL WEATHER SEALING—All body seams and joints are shiplapped to prevent leakage. Seams are further sealed with a special gun-applied mastic that stays pliable—won't dry out or crack with age.

4. NEW SOUND-DEADENING TECHNIQUES—Under hood, roof, and floor mats, heavy layers of special felt and rubber acoustical materials soak up road and wind noise. These sound deadeners are eight times as effective as the best of conventional sprayed-on materials.

5. SPECIAL SEALING FOR WIRES AND CONTROLS—Instead of punching separate holes in the firewall for entrance of control cables and wires, Dodge engineers routed major units through an ingenious self-sealing keyhole. There, special die-cut rubber blocks simultaneously position the wires and seal out drafts and noise.

6. COMPLETE RUSTPROOFING INSIDE AND OUT—Every Dart Unibody is deep-dipped seven times in tenacious rust preventives. This deep-dipping completely seals every crack and seam, inside and out. Final finish is then added—two coats of special primer, two coats of lustrous, long-lasting Lustre-Bond baked enamel.

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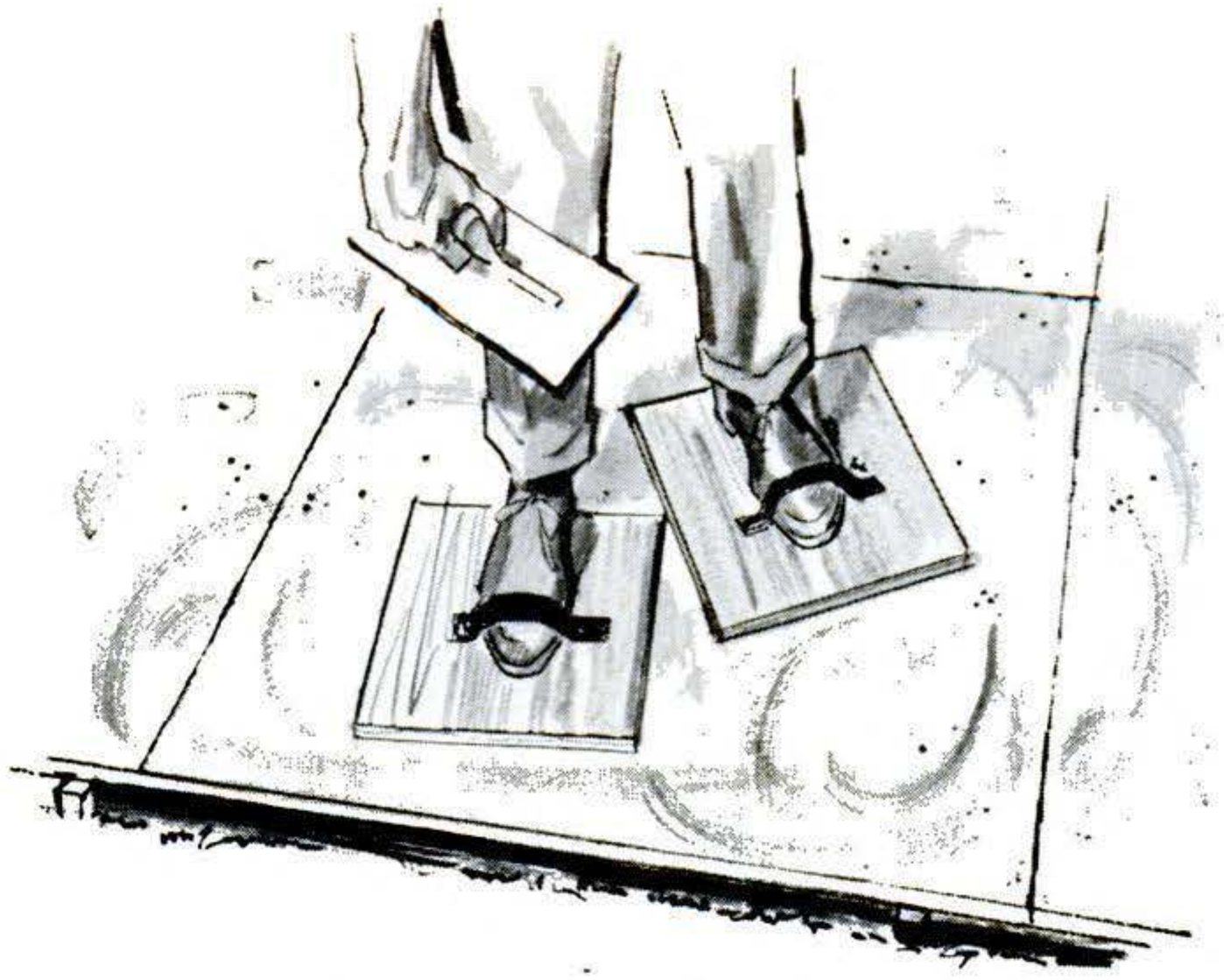
Short Cuts and Tips

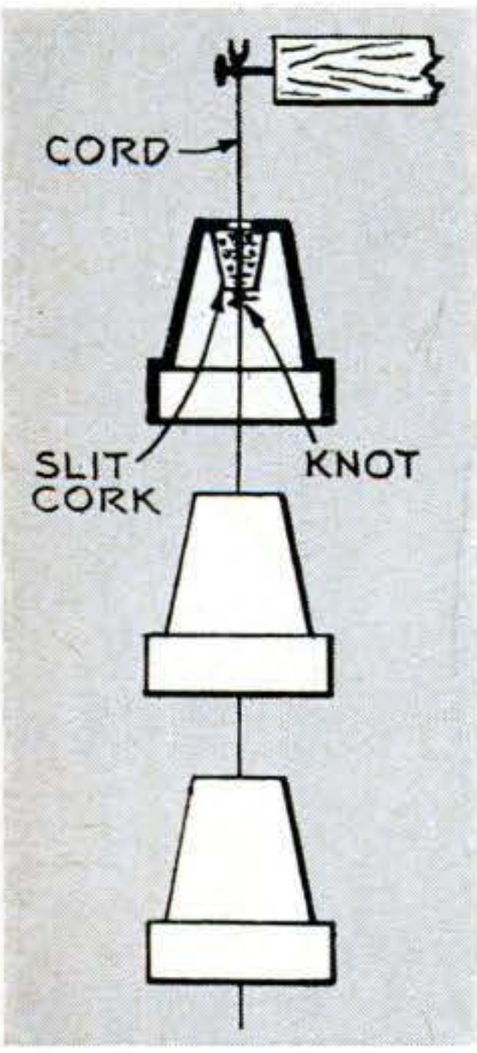
FROM PS READERS



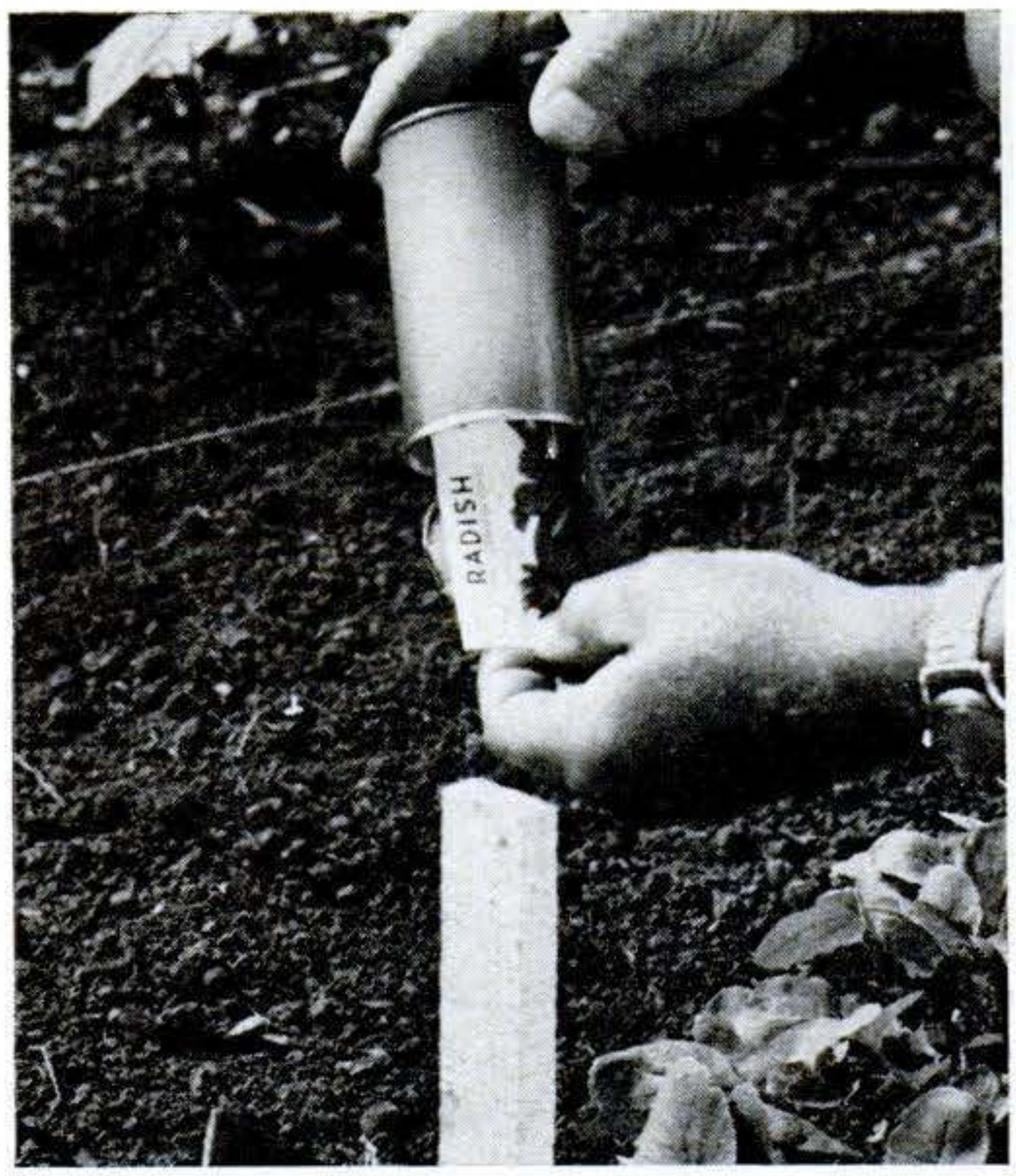
For Walking on Fresh Concrete

FOOT-SQUARE pieces of plywood fastened to your feet with toe straps will let you walk on fresh concrete to do handwork. You even can do some touch-up work with your feet, using the slippers as trowels.—*William C. Pierce, Dallas.*

Painting Flowerpots in Series



WANT to spray a number of flowerpots at once? Hang up a cord in which you have tied knots about 8″ apart. Split an equal number of corks. Then run the first pot, bottom-side up, above the top knot, and slip a split cork over the knot. Follow up with the other pots. The knots hold the corks; the corks hold the pots. —*Ray Moore, Wellsville, Ohio.*

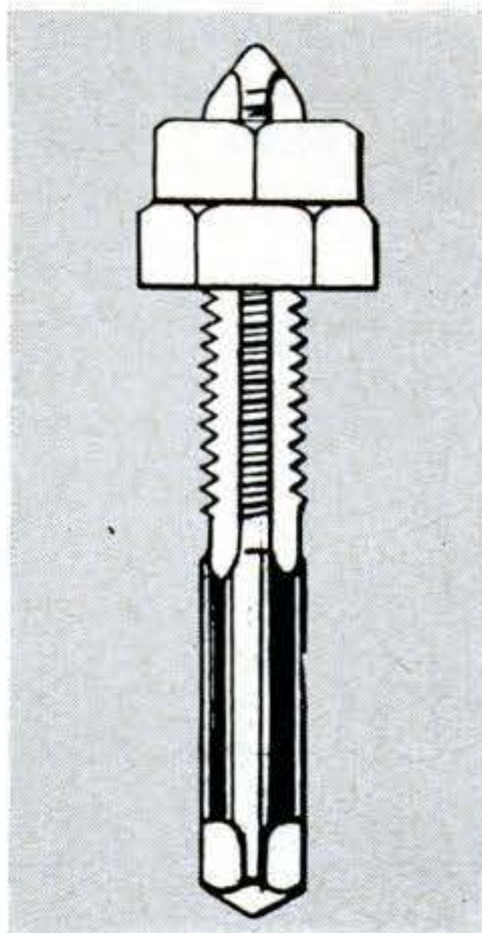


Using Cans to Mark Garden

SMALL frozen-fruit-juice cans make handy garden markers. Stuff the empty seed packets inside, and place the inverted cans over garden stakes. Enamel paint pretties them up and prevents weathering.—*Bill Toman, Palatine, Ill.*

Protecting Hand-Tap Teeth

HERE'S an easy way to protect the cutting edges of hand taps from damage while they rattle around in your toolbox. Run two nuts on the tap, just far enough to cover the tapered cutting teeth. Then hold the first nut while tightening the other one as a jam nut.—*Robert V. Thompson, Clinton, Iowa.*



▶▶▶OUR kitchen fan does a fine job exhausting cooking smells, but in cold weather it creates a draft. Since there is no way of regulating it, I place aluminum foil over ¾ of the fan grille—just right to remove the steam when we use the pressure cooker. Suction holds the foil in place when the fan is in use.—*Richard A. Couture, Somersworth, N. H.*

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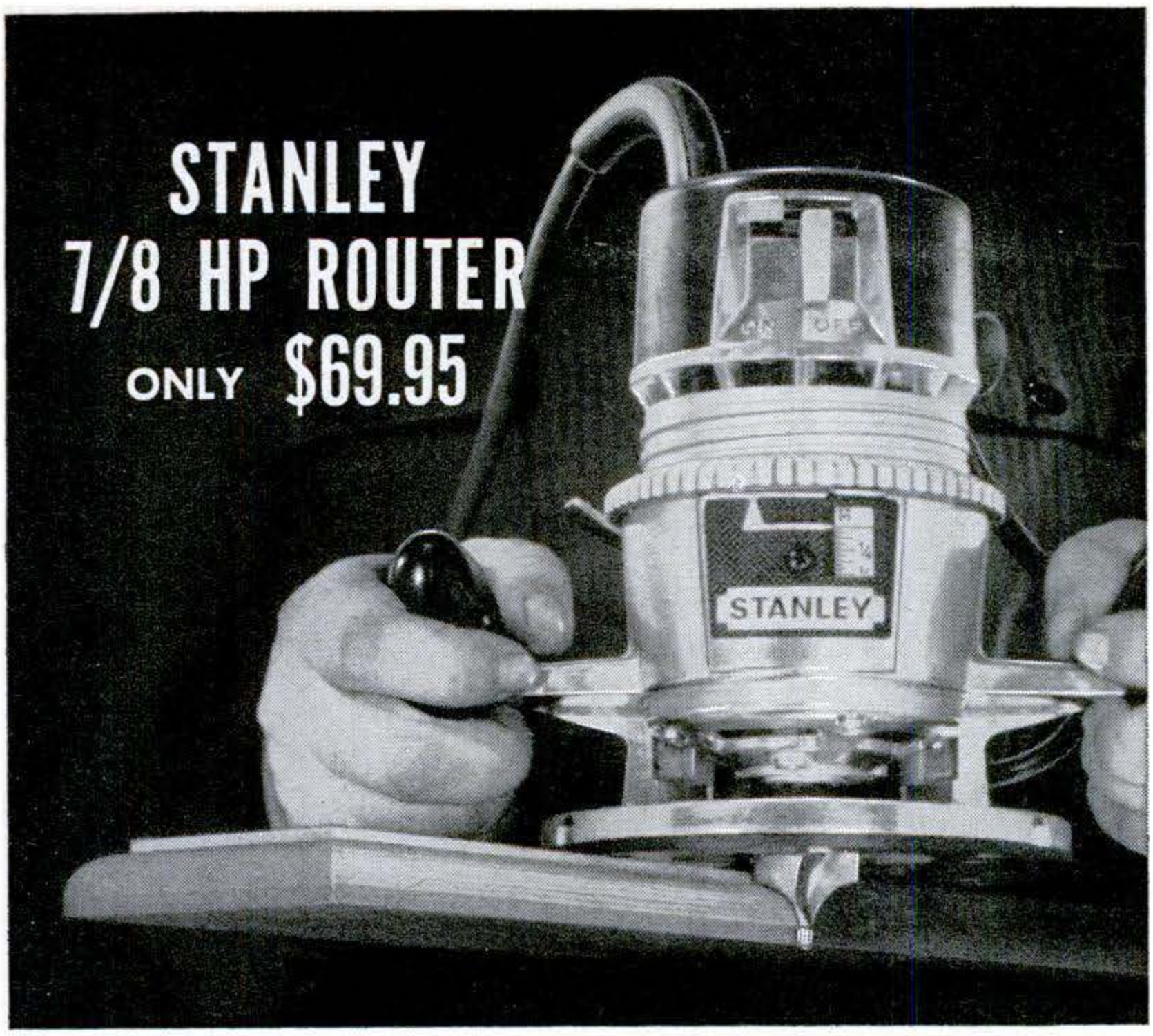

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Of all portable power tools, Stanley's "router with the light" is the one that helps you most in fashioning and finishing fine furniture or wood work of any kind.

Perfectly balanced, the H264 fits and feels right in your hands. You know you can achieve just the right mortise, bead, edge or dado because this is a tool designed to make exacting cuts exactly right. The exclusive Stanley spotlight spots the line and lights your way along it. The open base always lets you see what you are doing.

See the Stanley H264 wherever you buy tools. Heft it. You'll want it. For fully illustrated book, "Operation of the Modern Router," enclose 25¢ to Stanley Electric Tools, Division of The Stanley Works, 6303 Myrtle St., New Britain, Conn.

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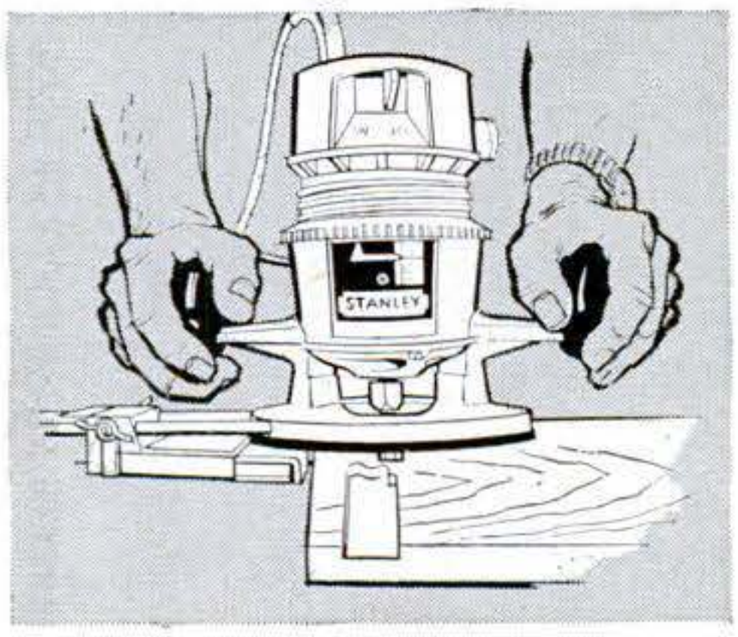
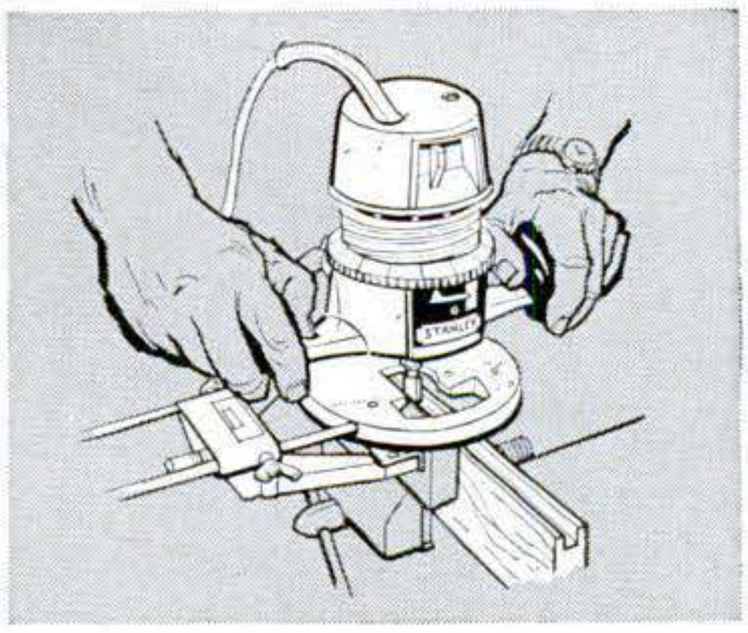
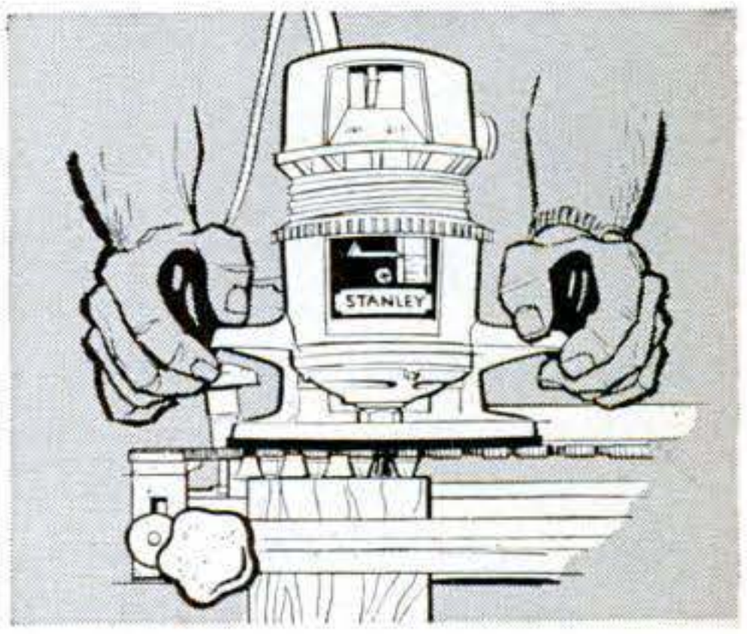


Cutting of dadoes can be done fast and accurately with the router. You are sure of exact fit, finer craftsmanship when making bookcases, cabinets, dressers, etc.



A Stanley router lets you cut true grooves or slots in the sides, back and front of drawers, boxes, trays, etc. You can even cut a perfect groove on a ¾-in. narrow edge!



The dovetail joint, very difficult to cut by hand, is done easily and perfectly with the versatile Stanley router and dovetail templet — just like the professional!

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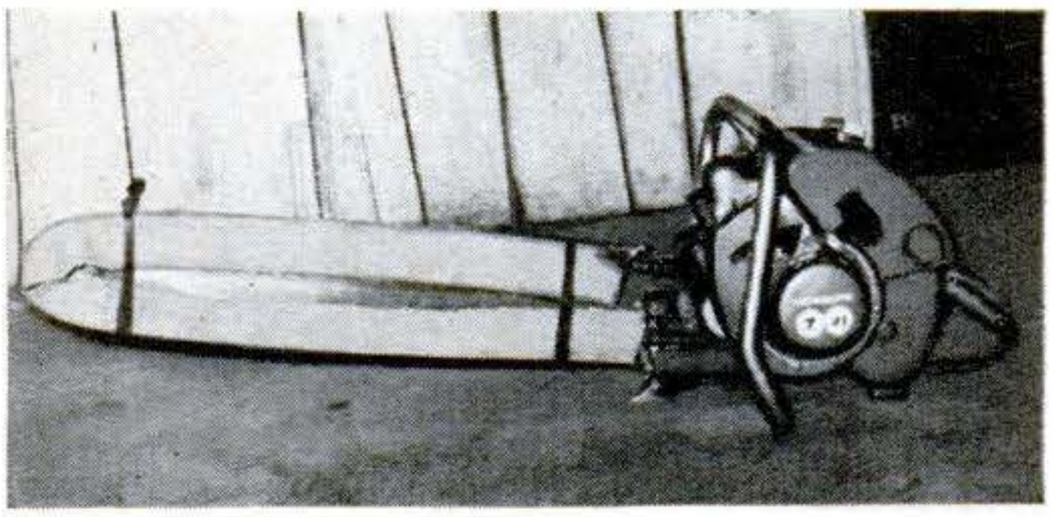
Short Cuts and Tips

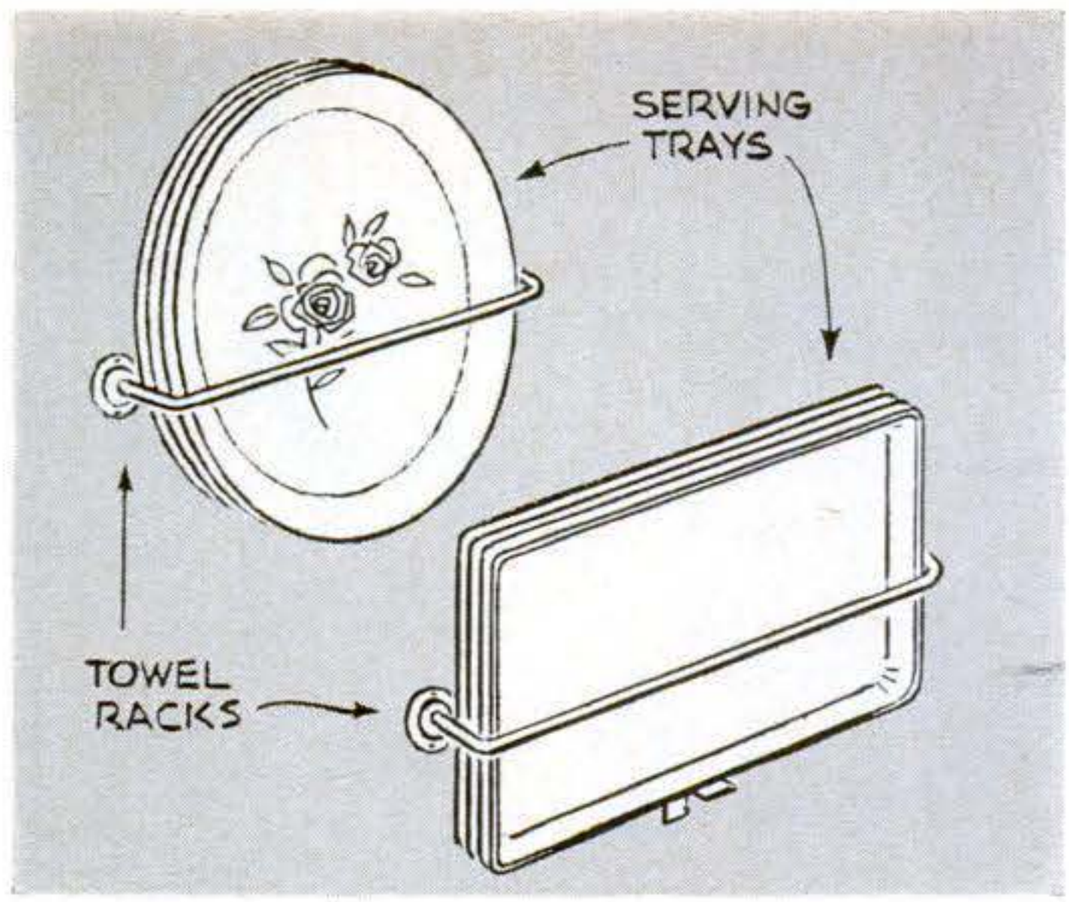
FROM PS READERS



Saw Guard from Old Hose

BOTH chain saw and user are protected from accidental injury when this guard is used on an idle saw. It's a length of old fire hose, slit to fit over the blade. A notch allows the hose to fold at the outer end; rubber bands cut from an old inner tube are used to hold the guard in place. —*Jack C. Raftery, Crater Lake, Ore.*

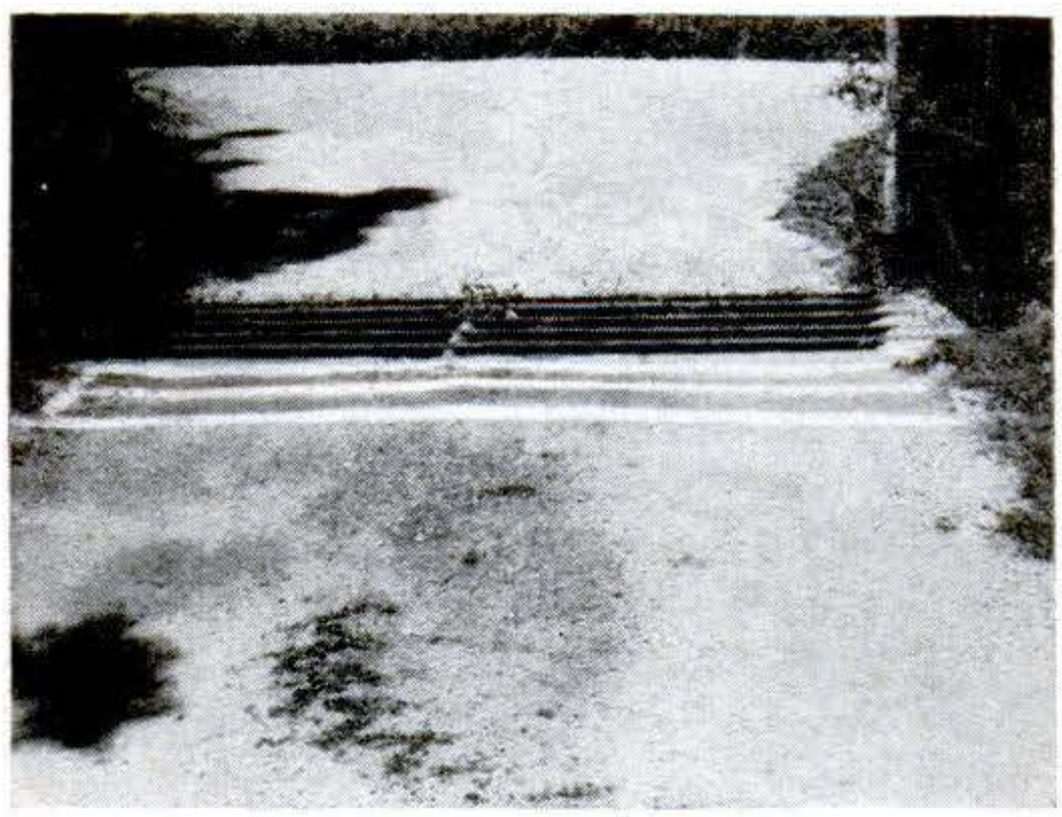
▶▶▶HALF of a child's sponge-rubber ball glued to a wood block makes a good tool for removing broken light bulbs. Shove the rubber section against the broken bulb neck and unscrew it. You'll be safe from cuts, electrical shock, and short circuits.—*Ben Edwards, Toledo, Ohio.*



Rack for Storing Trays

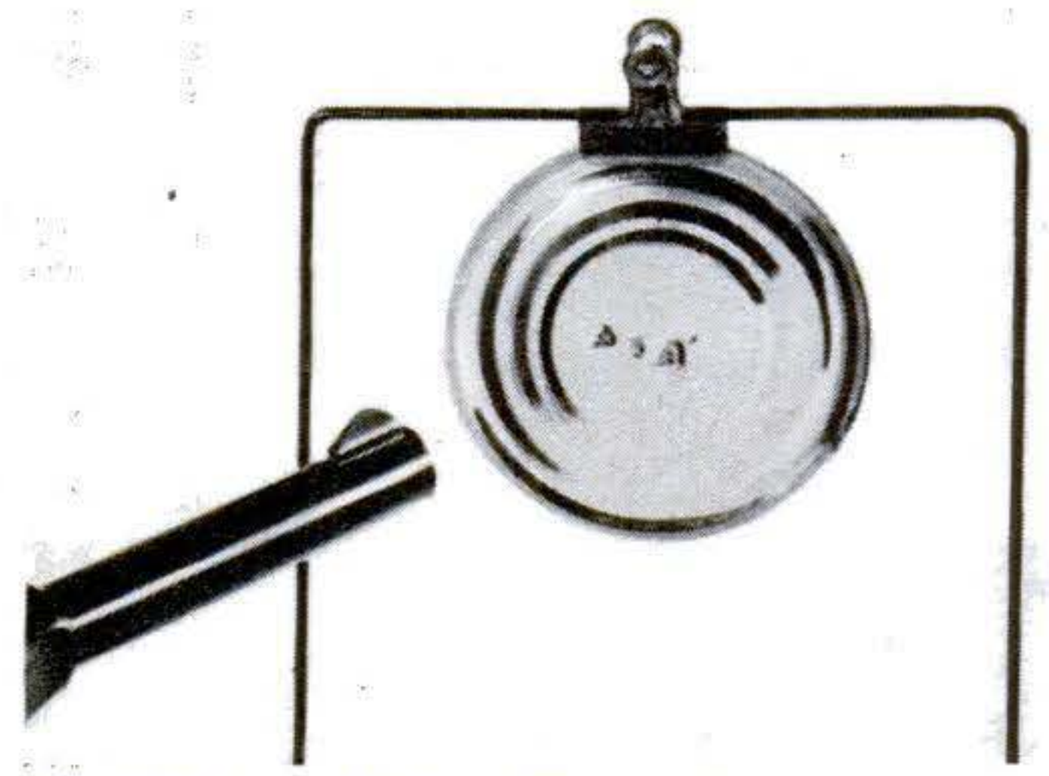
LARGE serving trays sometimes present a storage problem. Try placing an ordinary towel rack on an unused wall and storing the trays in this. For rectangular trays, use a towel rod a little longer than the tray, and screw a supporting shelf bracket or wood block to the wall.—*F. C. Gardner, San Angelo, Tex.*

▶▶▶BACKING sandpaper with strips of adhesive tape will make it easier to use on scrollwork. The tape reinforces the paper to prevent tearing when sanding in tight places and on curves, and makes it easier to shape the paper into a roll.—*Edward Bentley, Jackson, Mich.*



Fooling Cattle with Paint

SCIENTIFIC hearsay worked for a Tennessee cattle farmer. He'd heard cattle were color-blind. So when he found they were stepping over his four-bar stock gap, he painted three more bars on the ground. The false gap has worked well for three years—with annual yellow repainting.—*Robert A. Brown, Shelbyville, Tenn.*



Self-Resetting Target

TARGET practice is more fun if you don't have to reset your target. With this one, you can see your score from a distance, too. It's made by spring-clipping a tin-can lid to a coat-hanger-wire frame. Push the wire ends into the ground to support the target. The can top can take many direct hits.—*Bil Toman, Palatine, Ill.*

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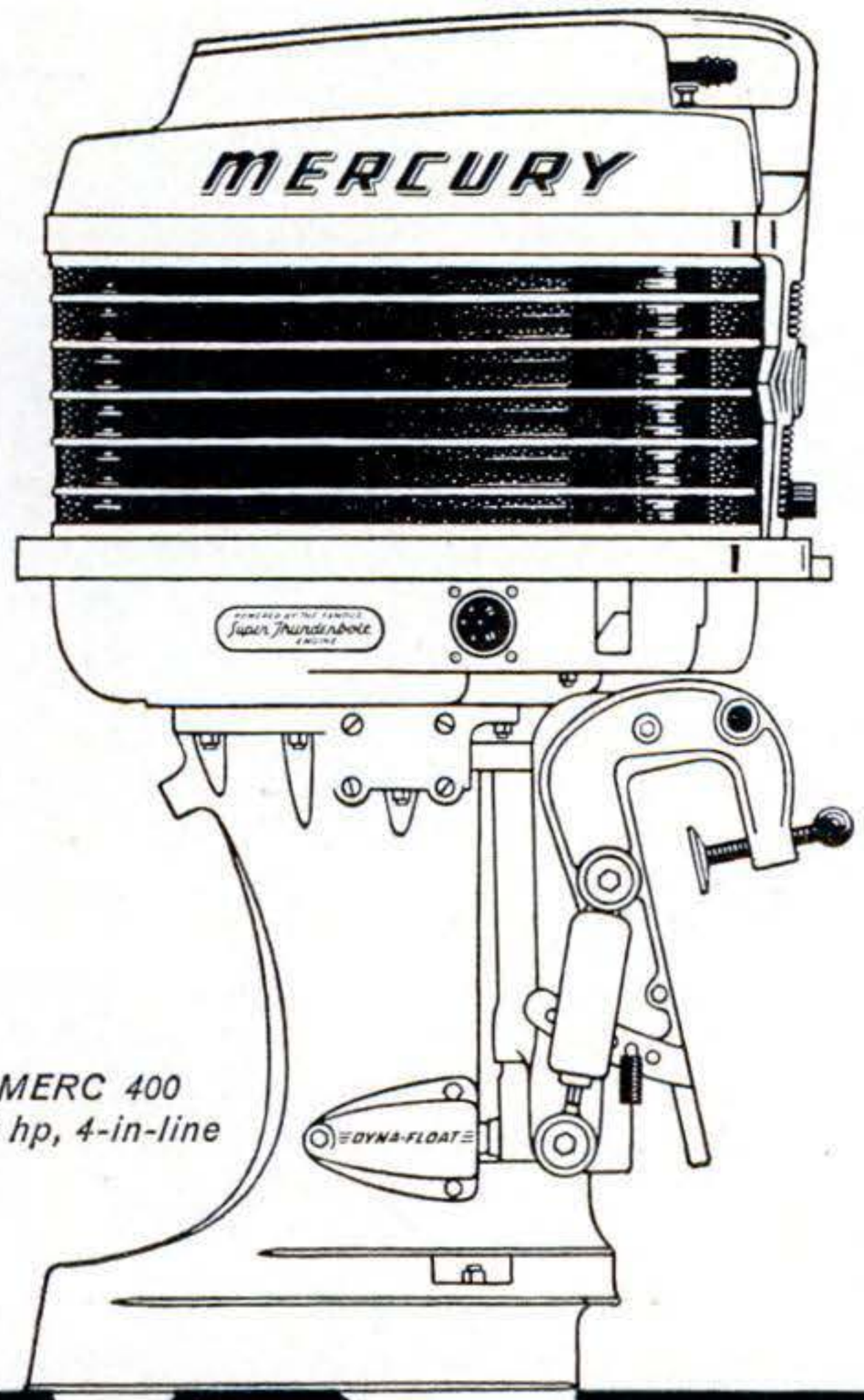

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45 hp, 4-in-line

Reliability is a built-in bonus you get in every Mercury — reliability proved in Mercury's world record 50,000 mile endurance run and Mercury's 107.9 mph world record. Mercurys outrun and outlast all other outboards because Mercurys are safety-engineered to thrive under treatment far rougher than you will meet in normal boating use!

Because of such Mercury features as exclusive Hydraulic Dyna-Shock Absorbers and Safety-Tilt Switch, forged aluminum clamp brackets, "Flo-Torq" Safety Clutch, and one-piece "Uni-Cast" gear housing, this Merc 400 can slam over a log time after time without damage to the motor, as demonstrated in the proving ground test below.

See your dealer for a demonstration of these and other features which make Mercury the World's No. 1 Outboard! Nine new models, 6 to 80 hp, in twins, fours and sixes.

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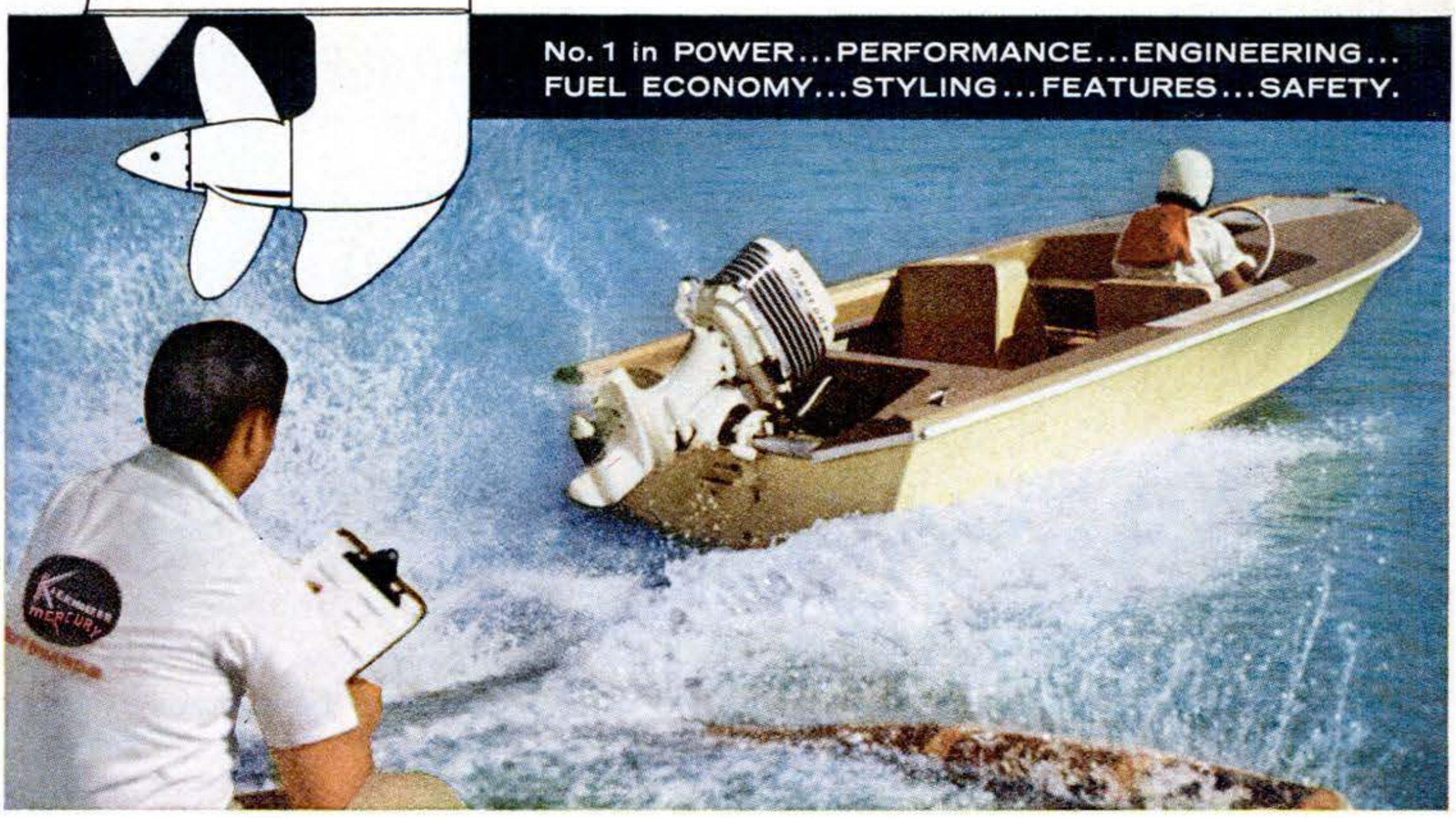

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In the field of domestic engines, two more cylinders make the difference between adequate transportation and spirited performance And sometimes performance is fun, particularly when the price is just a little more than the "6" The Lark V-8 in standard form pulls 180 hp at 4500 rpm and 260 ft. lb. of torque at 2800 rpm. With optional 4-barrel carburetor and dual exhausts, you get 195 hp at 4500 and 265 ft. lb. at 3000 so that drivers can turn zero to sixty in just over nine seconds Economical, too! In last year's Mobilgas Run, The Lark V-8 with automatic transmission topped all other eights The Lark V-8 is rugged. It runs on five massive main bearings and (here's the hooker), piston travel per mile in high gear (3.31 rear) is only 1380 feet. Engine revs per mile in high gear is an easy 2550 See your Studebaker Dealer and try The Lark V-8. You'll love it!

LOVE THAT LARK BY STUDEBAKER

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How Deadly Is the Black Widow Spider?
[Continued from page 107]

In garages, barns, storage sheds. Man provides so many excellent places for her webs that these spiders abound near his habitations."

Q ***What about outdoors—in the wild?***

A "She'll build a web almost anywhere that's protected from light and weather. For instance, in an abandoned burrow, or under a stone, or in a crevice in a dirt bank. Sometimes she gets above ground level—as in the tall cholla cacti of Arizona, or in birds' nests in pine trees, or in grape arbors in Colorado."

Q ***When are you most likely to encounter a black widow?***

A "Usually she is most conspicuous in late summer or fall. They're an annual, like most spiders. By late summer, most have attained full size, people see them, the newspapers hear about them. Most bites are reported between July and October. The male lives a few months, till late summer, breeds, and dies within the year. The female lives a little longer and lays her eggs—maybe 400 at a time. She usually dies in about a year, but sometimes survives the winter to live a year and a half or so."

Q ***Is it true that the female eats the male?***

A "She sometimes does. That's why the name—black widow. Often, though, the male escapes to mate again."

Q ***What if you're bitten by a number at once—as you might be by a swarm of bees?***

A "It won't happen. The black widow is a secretive animal, and she lives apart from others of her kind in a coarse web all her own."

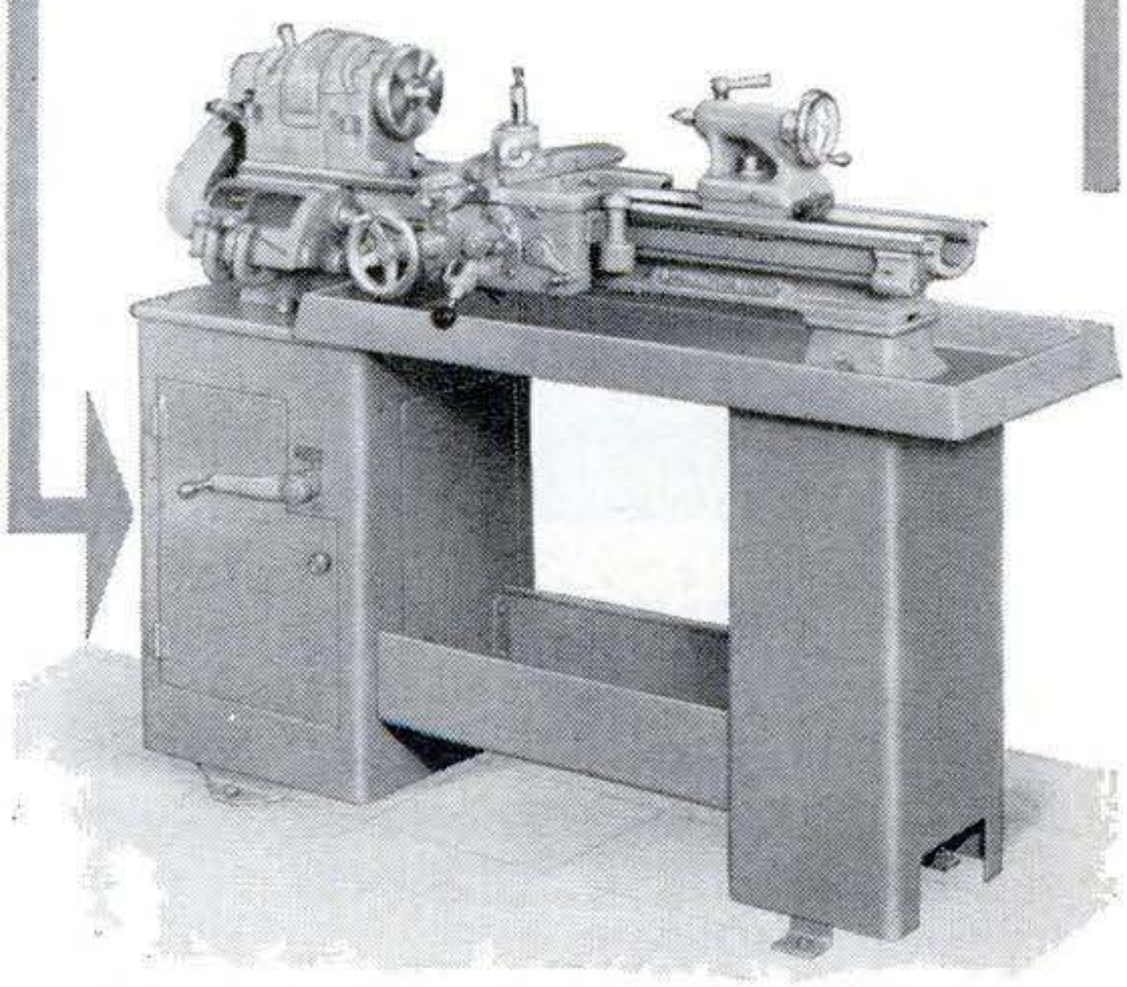
Q ***Has she any natural enemies?***

A "Small fly parasites and various wasps, especially mud daubers. That kind of wasp does kill a lot. Some black widows may be eaten by birds, as are many spiders, and even by skunks."

CONTINUED

South Bend

10" LATHES | *with new welded steel floor legs*



- New, trim floor legs . . . reinforced construction of welded, heavy gauge steel . . . maximum rigidity with minimum weight . . . no increase in price!
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Modernize your home by installing this beautiful hardwood floor over your old floors. Or use low-cost Bruce Laminated Blocks to create new living space in attic, basement or addition.

Easy to lay — Just apply adhesive (Bruce Everbond Coldstik) and lay blocks. Tongues and grooves assure tight fit. No nailing . . . and no sanding or finishing either, because Bruce Laminated Blocks are completely prefinished at the factory. Your new floor is ready to be used and admired as soon as you lay it.

Moisture-resistant — Blocks are 9″ square and only ½″ thick. The three oak plies are laminated under heat and pressure with waterproof glue to prevent expansion and contraction. Ask your lumber dealer for a cost estimate. Mail coupon for color literature on Bruce Laminated Blocks.

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How Deadly Is the Black Widow Spider?

Q ***Won't the venom harm an animal that eats the spider?***

A "Not in the case of wasps, anyway. We haven't assessed this in the laboratory. We have made the black widow bite small laboratory animals. Frequently, the small animal dies. Rats die very quickly from the bite."

Q ***How should you get rid of a black widow?***

A "A five-percent DDT spray will do it, but spray the web or the spider. Because she stays in or near her web, it won't do you any good to spray all around the basement. But the best weapons of all remain the shoe, broom, stick, and fly swatter."

Q ***Are there other poisonous spiders native to the U. S.?***

A "Until recently, I'd have said no. But we now know of a second venomous spider in the U. S. It's *Loxosceles reclusa,* and is so new it has only recently been given a popular name, the brown spider. Found in southeastern and central U. S., but best known perhaps in Missouri, it gets into houses, falls on people in bed, or gets into their clothes. After a bite, a local blood poisoning develops that results in the sloughing off of skin, and ulceration. I don't think this spider has caused any deaths here, but it is said to have done so in South America. In the southeastern and central U. S. it is just as common as the black widow right now —and more likely to bite you."

Q ***How would you estimate a person's chances of dying from a spider bite?***

A "Less than your chances of being killed by lightning. You're not likely to be bitten. I don't think half the people who say they're bitten have been. They may have been nipped by a biting insect, or they have a rash on the neck, or something. But I don't argue. If you are bitten, your chances of survival are at least 9½ out of 10. So you see I belittle danger from spiders. But don't misunderstand me. It's a painful, disagreeable experience, and I don't recommend it."

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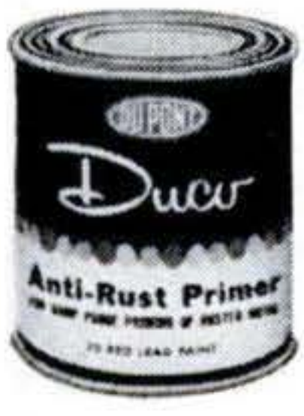
Another contribution from Du Pont Research! Anti-Rust Paints for every surface. "Duco" Anti-Rust Primers for damp-proof priming of rusted metal; for clean steel, tin and aluminum; for all galvanized and copper surfaces! "Duco" Wrought Iron Black for exterior or interior use. "Duco" Chrome Finish Aluminum Paint. And for colored top coats doubly durable Du Pont "Duco" Enamel. These new Anti-Rust Paints . . . today's best protection for metal, indoors and out . . . are all at your Du Pont dealer's—now.



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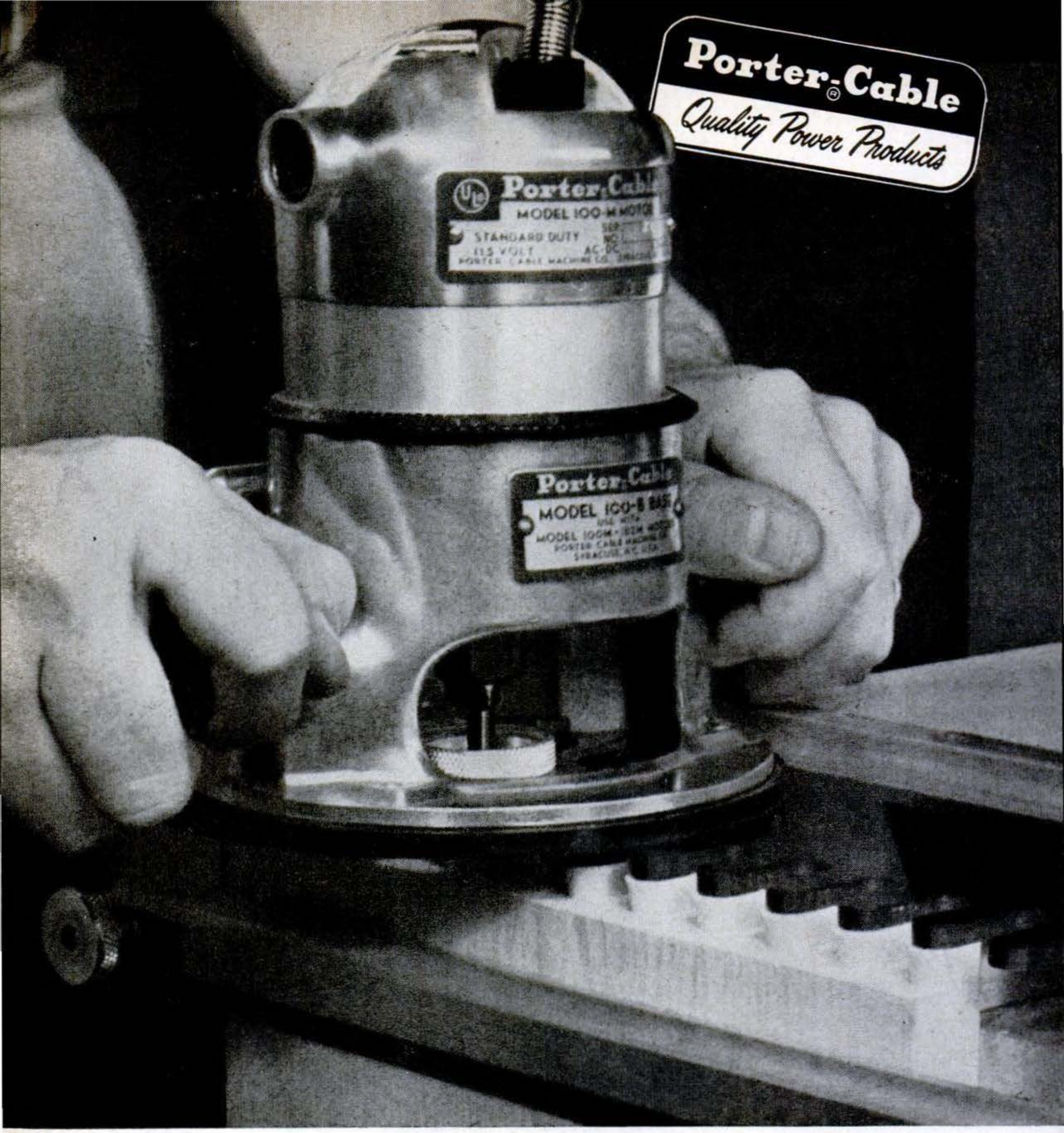

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From the manufacturer of the world's finest professional routers comes this extremely accurate Model 100 with many exclusive Porter-Cable features. Its high-speed, powerful motor assures chip-free cutting of difficult laminates. Plus features include twin molded plastic knobs, sealed ball bearings, precision micrometer-ring depth adjustment, non-marking base, lightweight for easy handling. Wide variety of bits, cutters and templets makes it the most versatile and useful production tool in any shop. Motor can be used interchangeably with Plane or Shaper Table attachments. *See this router demonstrated at your Porter-Cable Dealer.*

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[Continued from page 112]

on ideas that all are agreed on anyhow.

Draw out timid Jones by praising him publicly. Privately, you can caution other committee members to give him a chance to speak his piece.

More troublesome is a below-the-surface goal—recognized but hidden, and separate from the job you're supposed to do.

The hidden goal may be one man's alone. He may not care about parking, but only about making a splash the boss will notice. This misuse of committees to gain personal prestige is very common in after-hours public-service work. (Ever notice the way political comers suddenly acquire interest in charities?)

But the hidden goal may also be shared by the whole group. Is the Parking Committee really out to clobber an unpopular supervisor? It may pass up many practical schemes hunting for one that will force the hapless supervisor to park his car way out in left field.

For more information . . .

YOUR local adult-education program may offer a course in group dynamics under a label such as "Leadership" or "Committees." For a list of the booklets used in teaching such courses, write the Adult Education Association of the U.S.A., 743 North Wabash Ave., Chicago 11.

Books on the subject: *Dynamics of Groups at Work,* by Herbert Thelen, and *Group-Centered Leadership,* by Thomas Gordon.

Keep alert for hidden, unstated goals. Best ignore them, though, unless they interfere seriously with the honest purpose of your group. Then it might pay to lay it on the line: Let's get the parking job done and take care of that so-and-so in Building B later.

Actually, you can avoid these dangers. Harold Schmidhauser of the American Management Association explains how: "The group and its main goal must become more important to each man, temporarily, than his personal goals."

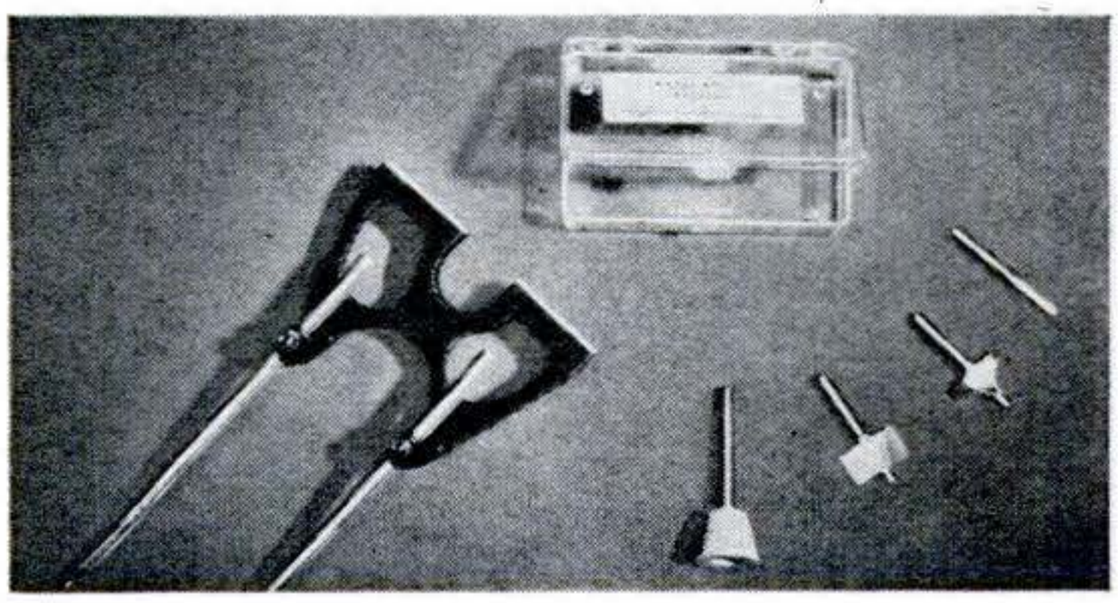
To weld your gang that solidly, says Schmidhauser, "the whole group should consider the problem, clarify it, and decide what the task is to be. That way the group gets the feeling that it's assigning the task to itself. No leader should get

CONTINUED

FREE! YOUR CHOICE OF ROUTER CARRYING CASE or 5-PIECE ACCESSORY KIT

Up to $15 in free accessories with your purchase of a Porter-Cable Model 100 Router!

ROUTER CARRYING CASE—carries everything you need to the job—router, templets, cords, etc. Special built-in shelf for bits, cutters, templet guides. "Fold-away" front puts everything in easy reach.



ACCESSORY KIT—basic assortment of bits for grooving, dadoing, decorative edging, rabbeting . . . plus a router edge guide for precision parallel routing.

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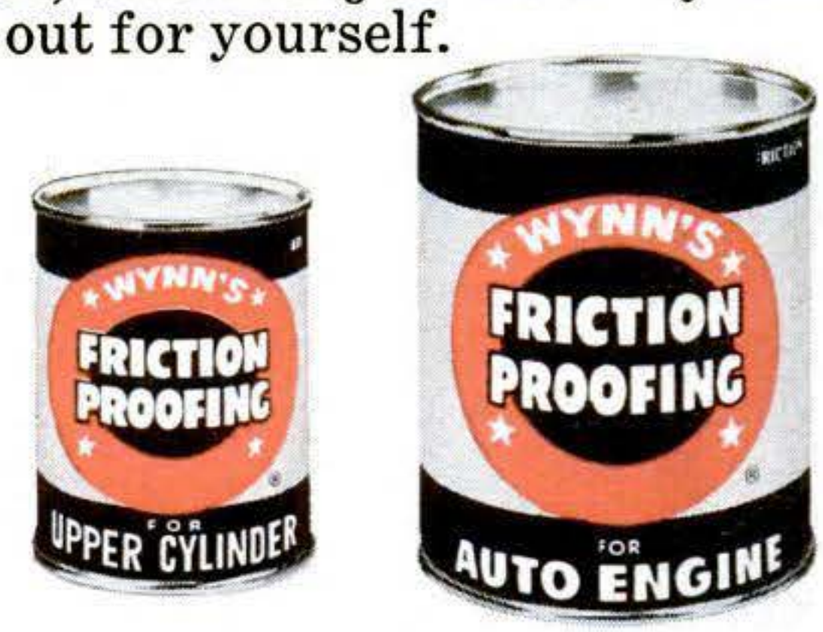

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up and outline the task in final terms."

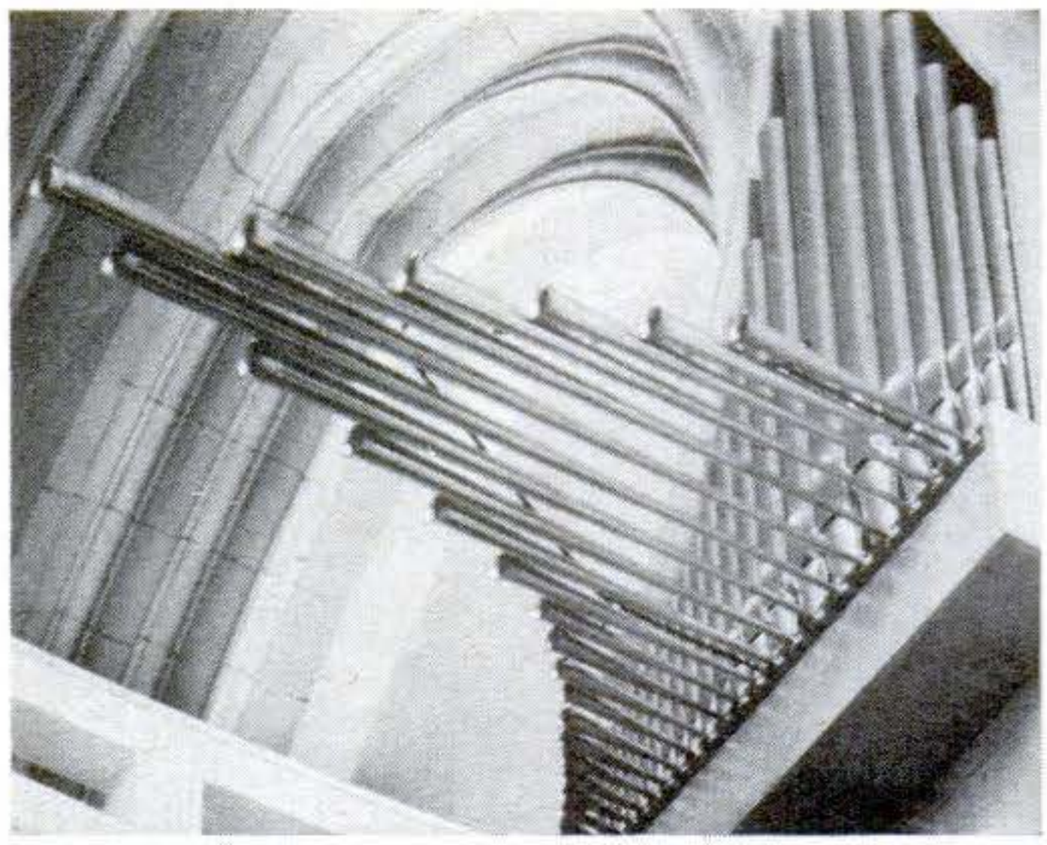
Schmidhauser tells of an employee committee formed to work up a recreational shindig. The chairman opened the first meeting by saying: "We've got to figure out arrangements for a company picnic—picnic area, buses, food and recreation."

The group didn't weld, slowly sank in a morass of emotions and personal squabbles, finally climbed out with a soggy program that nobody really liked. Preparations were just about complete when it became obvious that nobody was planning to show up.

Hastily, the committee met again. This time the desperate leader did things right: He mentioned the problem and that was all. The group threw out the picnic idea, which it would have done in the first place if given the chance, and came up with a night-in-town program that was a huge success.

Merely state the job at hand in very general terms, if you're the leader. If you're just a member and the leader specifies exactly what the group should do, challenge his outline. Try to start a good argument about it. (There are tactful ways of doing that, to avoid getting fired when the leader is your boss.)

These ideas for working with people in your shop, office, or civic organization can be money in the bank. They give you the edge toward leadership and the rewards that go with it. Work with a successful group, and memory of the group's success will follow you. END



CHURCH ORGAN. "Spanish trumpets" is the popular name of the unusual organ pipes installed in West Berlin's new Church of St. Matthias. Critics say they sound better than ordinary pipes.

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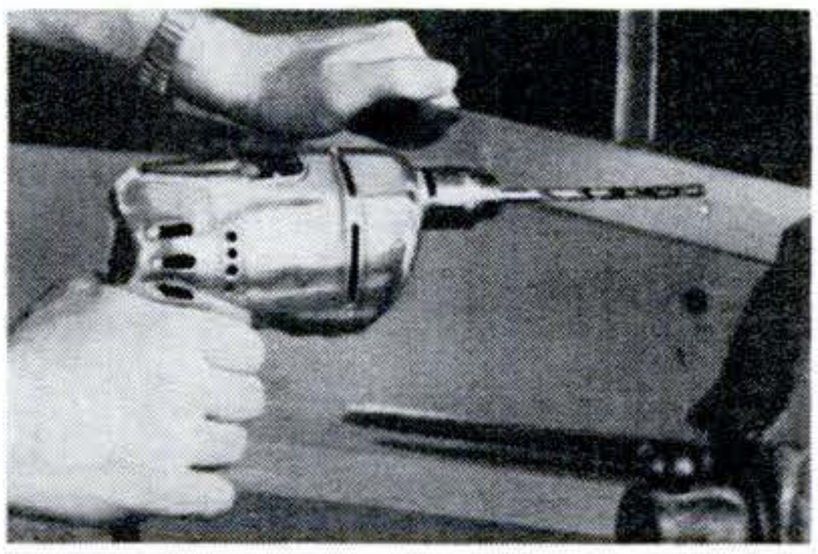

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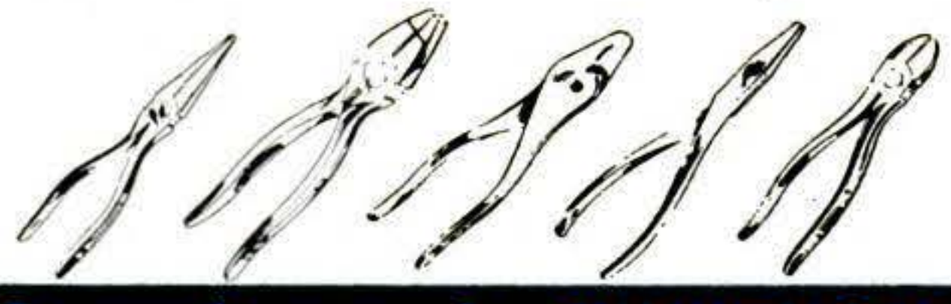

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Coal Travels Through a Tube

[Continued from page 137]

to last at least 15 years, it had walls up to nearly ¾-inch thickness, to allow for wear as coal particles scraped against them.

Pumping stations were provided with emergency reservoirs for dumping the arriving coal-and-water mixture, if the line should clog farther on; and water reservoirs, for flushing the line. The coal was heavier (specific gravity, 1.4) than the mineral carried in the western pipeline, and would be harder to keep from settling out. But a four-m.p.h. flow of the black fluid, designers figured, should keep the coal moving.

Sluggish slurry. Tests of the completed line began by pumping plain water through it. Coal was first experimentally added in February, 1957. In March, the pipeline clogged—inopportunely, just before the April 9 date when it was to be dedicated with appropriate fanfare. Seemingly the pumps had been unable to force coal up a hill south of Carrollton, and it had slid back and plugged the line.

Inquisitive reporters, finding the embarrassed company unwilling to talk, made a mystery story of it and prowled for themselves. A Cleveland newsman reported finding a hastily excavated pond, filled with tons of coal and water, in a wooded ravine. Engineers and workmen, he said, were cleaning out the line. "Slurry in No Hurry," a headline quipped.

Early in April, Consolidation recovered its voice. The coal simply hadn't been ground fine enough, it said; something had gone wrong in the preparation plant. Now the trouble was fixed, and the line unplugged. But only water, it seemed, was being pumped through.

In June, 1957, Consolidation announced a successful test run, "the first time coal has moved through the entire pipeline." (About the same time, Russia reported placing in service a successful 12-inch, 38-mile-long pipeline for coal.) By May, 1958, the Ohio tube was working up to three weeks at a time, alternating with shutdowns of two to 48 hours.

Success at last. Finally, in mid-1958, Consolidation was able to announce that its $12,500,000 coal pipeline was in full commercial operation. By year's end it delivered a million tons of coal to Cleveland Electric. Successful at last, it's cur-

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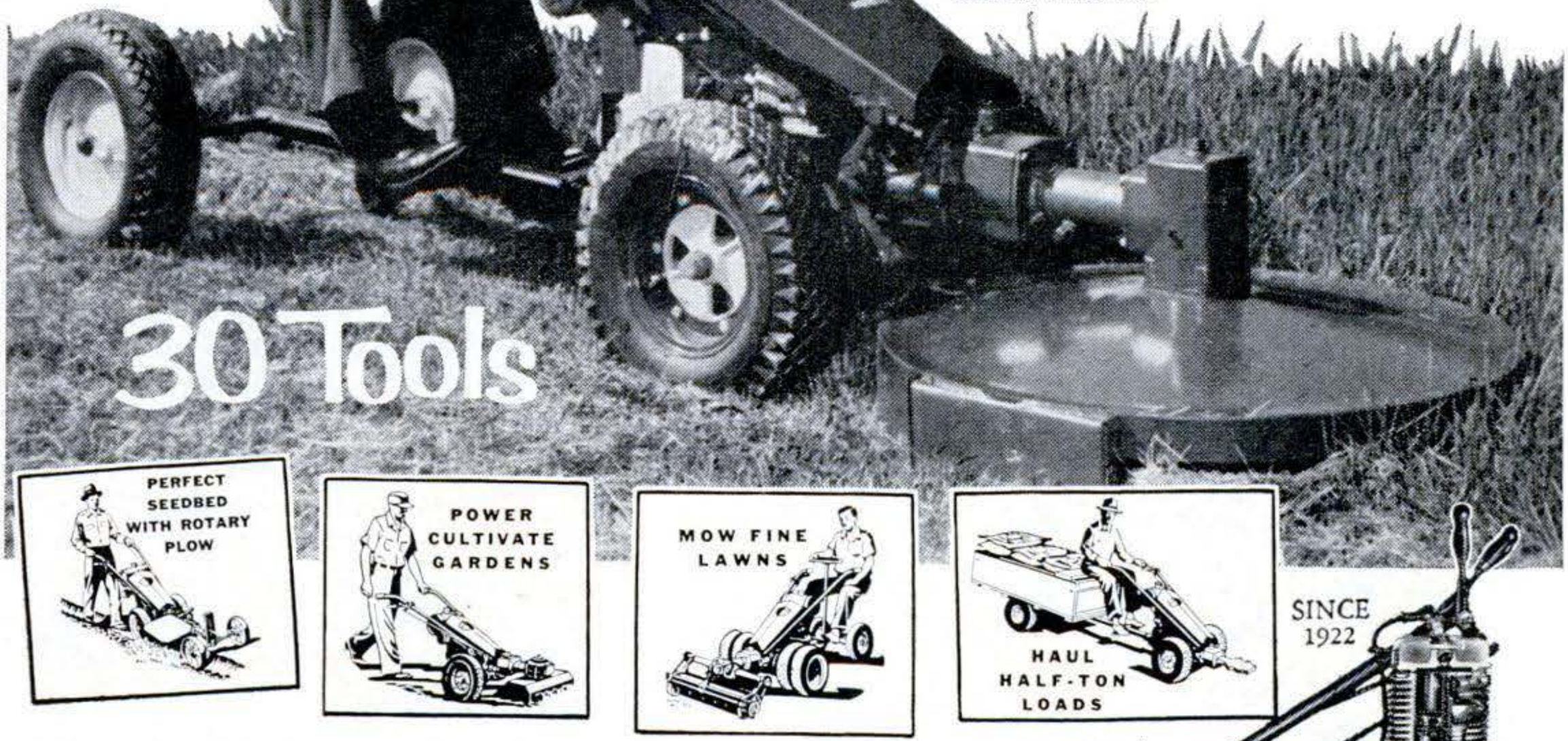

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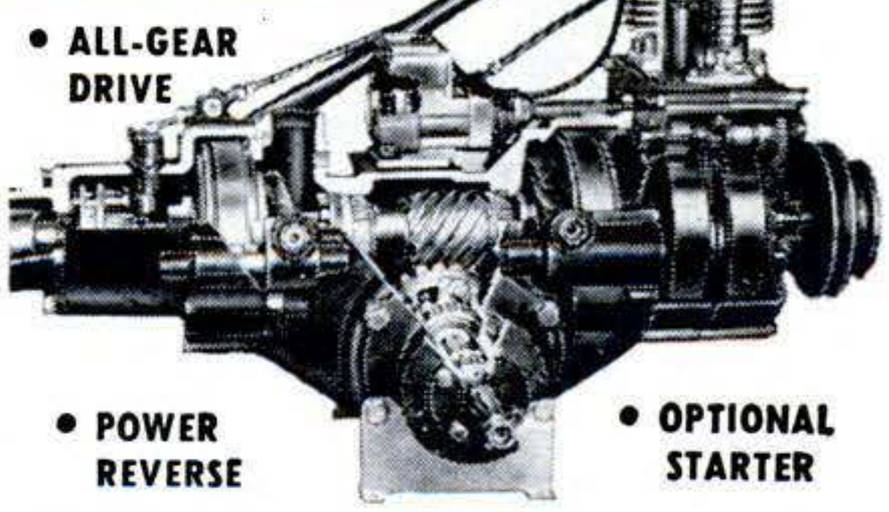

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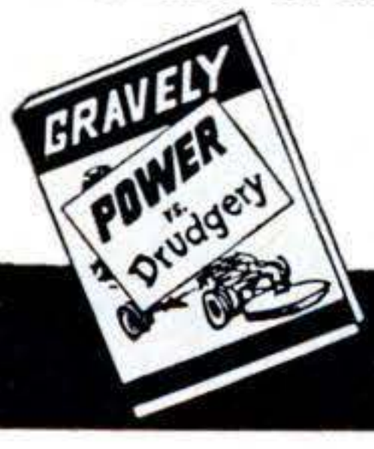

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rently operating at the rate of 1,700,000 tons yearly, far more than its planned 1,200,000-ton capacity.

Just as water can convey solid materials through pipelines, so can air. Comparatively small-scale so far, examples of pneumatic pipelines range from one that blows coffee beans through a 4½-inch tube between two buildings, in Knoxville, Tenn., to a mile-long pipeline for wood chips at St. Helens, Ore.

Now a New York engineer, Theodore Nagel, has designed and patented a system to carry coal by pneumatic pipeline for 100 miles or more. This dry pipeline, say of 10-inch diameter, would obviate having to de-water the delivered coal for use. Key feature of Nagel's plan is a "micronizing" apparatus he's devised, which would grind the coal to ultrafine particles five microns or less in size. The resulting smokelike mixture of coal and air could travel 50 miles between blowing stations, he says, without any settling-out problem.

Looking ahead. Engineers see the Utah-Colorado and Ohio long-distance "solids" pipelines as forerunners of a variety to come. Projects already reported under serious consideration include:

- Bringing wheat by pipeline from Canadian provinces to the Great Lakes.
- Carrying crushed limestone by pipeline to cement plants 50 to 75 miles away—a South American project being surveyed by a U. S. firm.
- Piping pellets of taconite (iron ore) from the upper Great Lakes region to major U. S. iron and steel centers.

And the boldest scheme of all for the future envisions building a chemical factory into a pipeline. The idea comes from the Pulp and Paper Research Institute of Canada, where an experimental pipeline is testing whether wood chips can be piped long distances in water. If so, the experimenters suggest, it should be possible to inject chemicals near the line's end—and then pass the treated mixture through a heated section of pipe. Thus they'd "do a bit of pulping en route," a step on the way to making paper or boxboard. So intriguing are the possibilities of such a tubular chemical plant—this is just one example—that the Canadians jokingly call their study "our project to make everything obsolete simultaneously."

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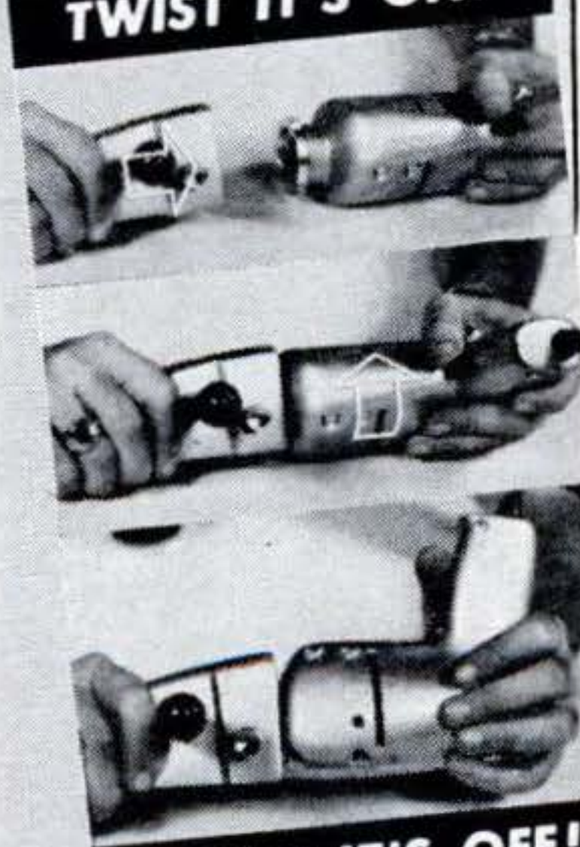

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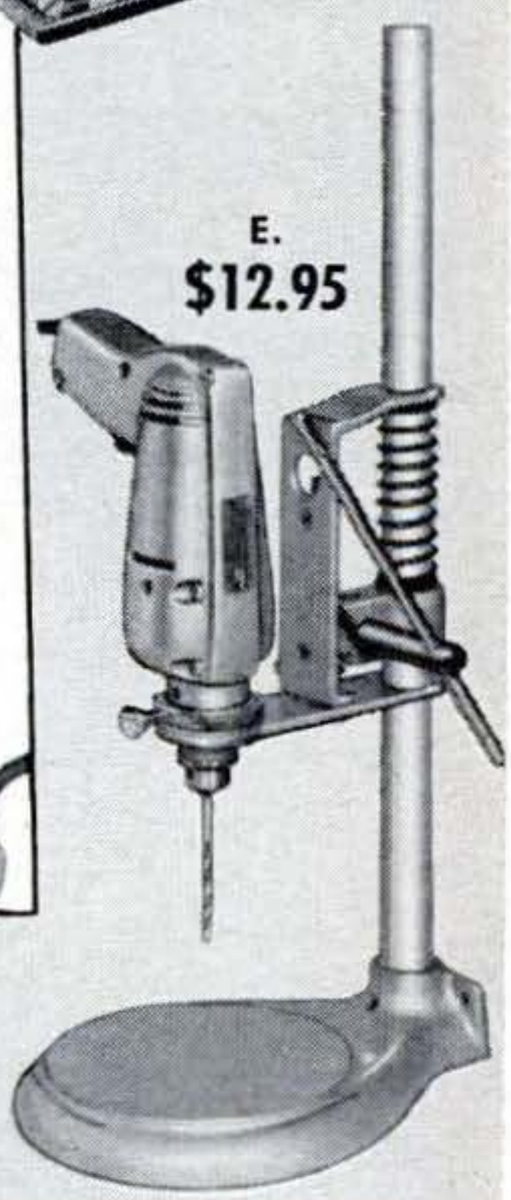

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Ball-Turning Attachment for a Lathe

[*Continued from page 172*]

The lock ring and its friction button for the South Bend attachment are made together. Rough-turn and rough-bore the required diameters on the lock ring and then, in the drill press, cross-drill into the bore with a No. 3 drill. Make a bronze pin about ¾″ long that is a drive fit in this hole. Drive the pin into the hole until it is flush with the inside bore of the lock ring. Rechuck the ring, finish bore, and turn to size, then cut the ⅞″-20 threads inside. In this way the threading tool will cut the exact thread shape on the end of the bronze pin. Clamp the finished ring in a vise and drive the pin inward until it falls free. Chuck the pin by its blank end, turn about .003″ off the diameter, and part off to length. Tap the No. 3 hole in the lock-ring edge to ¼″-28 to receive the socket-head capscrew that will bear on the friction button. Use the long leg of a standard hex setscrew wrench in the socket of the capscrew as a lever to tighten the lock ring.

An alternate method of securing the lock ring, by using ¼″-by-¼″ headless socket-head setscrews through the face of the ring, is shown in the blueprint for the Atlas attachment. Make a trial assembly of the attachment and tighten the lock ring in place to locate the setscrew holes. They should be positioned so that the setscrews will *not* coincide with the divisions between the split-ring wedges when the lock ring is tight.

A special spanner wrench with pins to engage the setscrew sockets can be made for tightening the lock ring. However, ordinary hex setscrew wrenches inserted in the sockets with a bar used between them will give you all the leverage that you need.

The pivot post for the Atlas is held in place with a ¼″-20 socket-head capscrew ¾″ long. The compound mounting stud on the lathe must be drilled and tapped to receive this. The compound mounting stud on the attachment is secured with a $\frac{5}{16}$″-18 socket-head capscrew through the mounting plate.

The dog-leg toolholder is best made of hardenable steel, but for light-duty work, mild steel will do. Be careful to file the bottom of the $\frac{9}{32}$″ square hole as flat as you can, so the bit won't rock.

The remaining parts, with the excep-

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tion of the brass ball for the handle, are made according to the blueprint, following standard lathe practice.

The ball for the handle will be your first job with the attachment. Prepare the workpiece, a cylinder of brass 1 1/8" in diameter and 1 1/8" long. Drill and tap the center of one end to 7/16"-14 about 3/4" deep. Mount it on a spud of scrap cold-rolled steel, threaded to match.

Assemble the completed ball-turning attachment. Pictures and captions accompanying this article show you how to proceed in setting up and turning the ball.

With the adjustment described in your lathe manual, take up nearly all the end play of the lathe spindle. This is important. Since the force of the tool will be alternately inward and outward in a single swing of the ball-turning attachment, any end play in the spindle can cause trouble.

The best way to grind the bit will only be found with experience. As a starter, study the way the tool point moves as you swing the handle of the attachment through its complete arc. You'll see at once that the bit wants to be some variation of a right-turning tool. It's mainly a side-cutting tool, but must also cut on its end to bite into the spud for final parting off.

Sockets are turned a little differently. The initial setup is made as for ball turning. But now, once the tool tip is locked at the center, it may not be adjusted sideways at all. Note the micrometer collar reading on the compound, back off enough to remove the approximator, then return the tool to its original point. Now advance the tool past this center point exactly the amount of the desired radius. Move the carriage up to the work. Make short swings with the attachment, advancing the carriage a little after each pass, until you have cut a deep enough socket for gauging. Chalk the ball the socket is to fit and touch it in the socket. If it marks only the rim, the radius you are cutting is too small; if it marks only the bottom, it's too large. Adjust the tool advance as needed until the chalking indicates a close fit. Once the radius is accurately set, you can cut any depth of socket up to a hemisphere without further adjustments.

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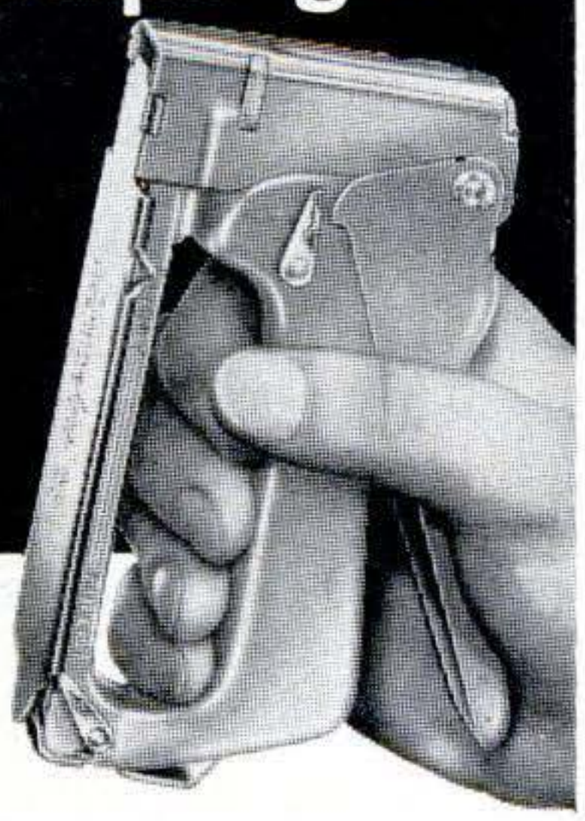

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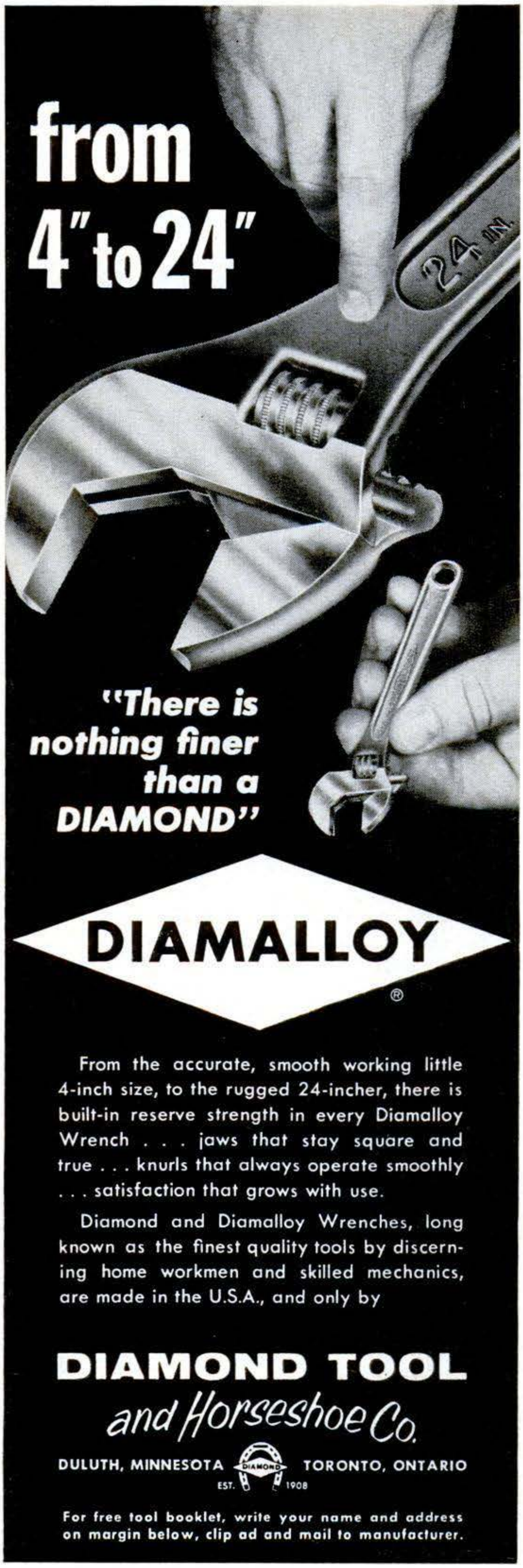

Riding with a Million in Cash

[Continued from page 91]

bulk of the car and the bank wall. He moved fast to his post a few feet to the right of the bank door. With his back to the wall, he scanned the street.

Meanwhile, Weiss had slipped across the cab, jumped down, and taken a post to the left of the door. The two men scanned the street again. All clear.

Felekey raised a hand in prearranged signal, and Hunt, gun drawn, stepped down from the back end. I was left with guard Angelo Faccone, gun also drawn, in the "vault."

"Rule Number One," said Faccone, "is to get your back to the wall fast. And Rule Number Two is to spread out so no one bandit can cover two men."

Anticipating trouble. In the car there was no sound but the hollow roar of the blower. I knew it was bulletproof and teargas-proof, as were the static vents, but that was small comfort. I fidgeted. "What happens," I said, "if some smart guy decides to break open the cab and drive this thing off?"

Faccone touched a button in a panel above the door. "This cuts off the ignition," he said quietly.

But in a minute I got that stranded feeling again. "Suppose five guys should rush us—I mean you—and smash the glass with a sledge hammer."

"This switch," said Faccone, "sets off the 'howler.' Guaranteed to bring every cop from miles around."

Motionless, gun still in hand, Faccone watched the bank door. I peered over his shoulder. "Don't the customers get in your way, foul up your routine?" I said.

"Sometimes," he said, "but they jump when they realize who we are."

"Kids ever bother you?"

He snorted. "Not kids, grownups. Kids look at your gun and say, 'O-o-o-h,' but adults put their hands on your ammo belt and say, 'Are those bullets real?' Or, 'Mister, is that gun loaded?' "

Faccone scanned the street methodically. "The worst guy," he went on, "is the wiseacre who comes up behind you on the steps, shoves his finger in your back and says, 'This is a stickup.' One of these days . . ." He didn't finish.

The critical moment. It seemed like hours before the crew came back. Felekey stepped quickly out of the bank and

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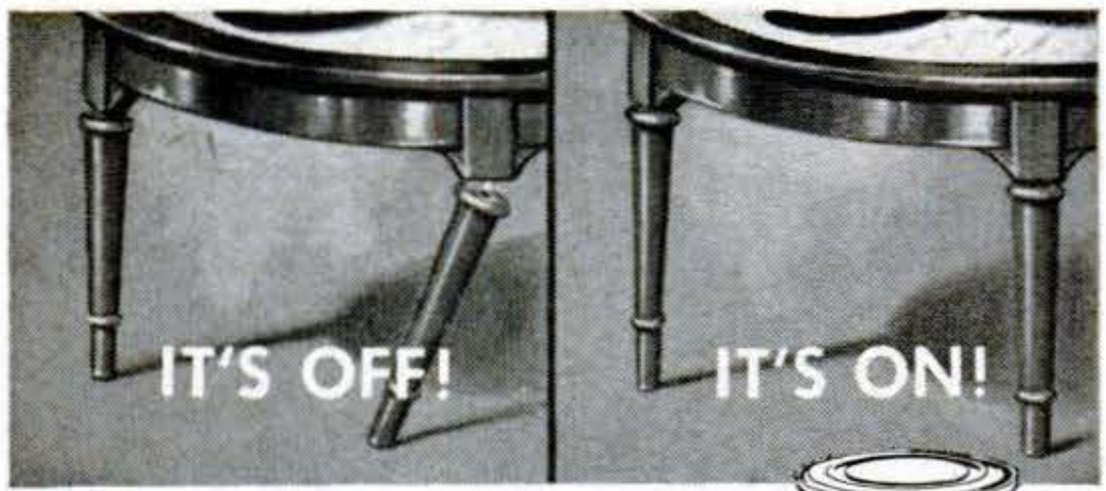
TABLE TIPSY?



Reset loose legs with firm-holding Plastic Wood. Can be sanded, painted or varnished.

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PLASTIC WOOD

Handles like putty—hardens into wood!

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CLOGGED SEWERS

REMEMBER THE COSTLY PLUMBING BILL—

Attachable Cutter Blades

Chicago—Mar. 1. Just introduced is a Free Booklet on machines which enable the Home Owner, Janitor or Factory Maintenance Man to Rod-it-himself—

Yet anyone can operate this **new Rodding Tool** which is whirled down the drain in a few seconds. SINKS, BATHTUBS, TOILETS, URINALS, FLOOR DRAINS, HOUSE TO STREET SEWERS can be cleared of Rags, Grease, Paper, Sand while Cutter blades can be added for removing roots. A new discovery in Swedish Music Wire gives the rod 100% more Flexibility.

Another new unit is the Miller Electric Rodder which has patented cutters that expand automatically to the size of the pipe. It will clean out heavy obstructions in pipe diameters 3" to 12". Smaller Sizes available. But now, what are these Tools worth in **COSTLY PLUMBING BILLS SAVED.** Tear this Ad out—and write your name and address beside it for **FREE BOOKLET** on Hand and Electric Units. Obey that urge. No Agent will call. A postcard will do (Chicago Phone Kildare 5-1702)

Miller Sewer Rod, Dept. PR-3, 4640 N. Central Ave., Chicago 30, Ill.

ADJUSTABLE MITER BOX & CORNER CLAMP

No. 44—COMBINATION MITER BOX AND CORNER CLAMP

Holds the wood and holds your saw. Uses any handsaw for accurate cuts from 0° to 180°. Full 3" capacity. Sides of joints exposed for nailing, gluing. **$2.75 PPD.**

No. 33 Works the same as No. 44, but without saw guide attachment. **$1.75 ppd.**

SAW SHARPENING IS EASY — FREE LITERATURE

Super Filer No. 11 joints and sharpens hand and circular saws 6" to 10" with all teeth correct in height, depth, pitch, bevel. When file hits steel roller, teeth are finished. Saw runs true with no side pull. Includes 8" file. **$9.95 PPD.**

"TRU-CIRCLE" saw set automatically sets teeth at 10° or more. **$2.95 PPD.**

MONEY BACK GUARANTEE

A. D. McBURNEY, 5908 Hollywood Blvd., Hollywood 28, Cal., Dept. S-30

Riding with a Million in Cash

moved well to the left of the door, Weiss to its right. Both kept their backs to the wall. Hunt appeared, looking for an okay signal from the "vault." Then he moved swiftly across the sidewalk and unloaded. The door clanged shut.

Even when each of the outside men has a bag of money, the rule is that only one is to approach the truck at a time. Always there must be two men behind, covering the man unprotected by a wall.

How to count money. As Weiss pointed the car out into traffic, Hunt and Faccone arranged the coin bags on the floor, half-dollars in one row, quarters in another. They determined what each contained by tapping it and listening to the clink.

"How much in each bag?" I asked.

"Except for pennies, a thousand dollars."

I counted quickly. One stop and there was $14,000 in coin at my feet.

Resting his knees on the coin bags, Hunt swung the big sacks of currency into the wall safe. They were white canvas sacks, clean, each about the size of a portable typewriter. Ordinary sacks, except that these were stuffed with paper money. I read the tag on one: $230,000.

Five tons of cash. By midafternoon, following the same cautious routine, we had picked up some 160 bags of coin. They lay two feet deep in ordered rows across the floor. In the safe were dozens of sacks bursting with almost a million dollars in bills. Altogether, the crew hoisted aboard about five tons of negotiable cash that day.

Back at the garage by 6:00 p.m., we were cleared by the man in the turret—since the Boston robbery, a guard monitors all doors in the building from a central bulletproof chamber—and drove under the roll-up door. I checked out with the assistant branch manager, Dave Williams.

"Hauling money is a tough job," I said.

Dave said, "We get a few laughs. I remember when we used to pick up the day's receipts for a clothing store and deposit them in their home office. They used a big currency bag and it was full every day. But we knew from the receipt that the money—even in singles—couldn't possibly fill the bag. We found out later that we were hauling clothes to the company tailor for alterations."

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A Low-Cost, DeVAC GlassWall Convertible Family Room . . .

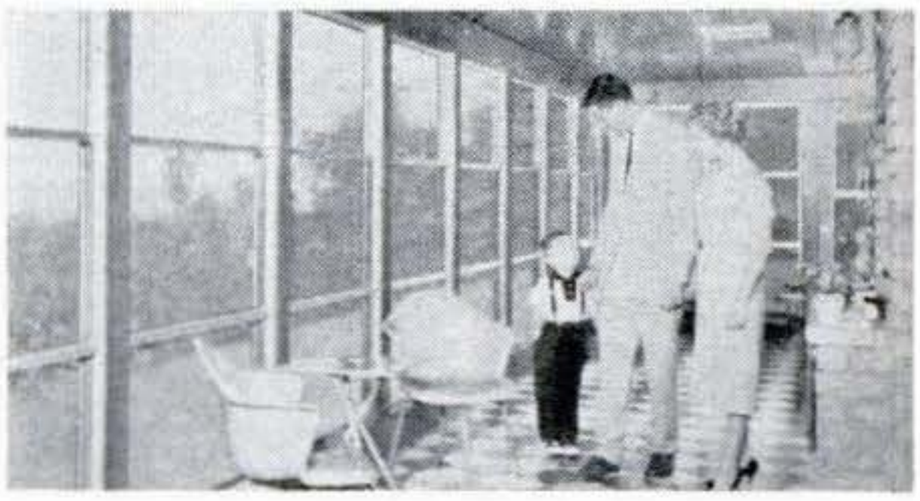
DeVAC Glass-Walls

Here's a new, practical way to remodel your summer porch, or build from the ground up, with DeVAC GlassWalls. In just a matter of a few hours your porch becomes a beautiful, sun-drenched extra room for year 'round livability.

Unique modular construction of DeVAC GlassWalls permits rapid installation with only the normal carpenter's tools. As a result, the final cost of building a GlassWall room is less per square foot than most other construction methods.

And DeVAC's exclusive 3-way directional control ventilation lets you convert your new room to meet the whims of weather—winter or summer.

BEFORE: Summer porch, wide open to cold, wind, rain and snow. Porch furniture must be moved in and out according to the weather. The porch is usable only a few days a year. The rest of the time it's just so much wasted space.



AFTER: A beautiful year 'round room. In winter it's a warm, cozy "living" room. In summer the unique three-way sliding glass panels glide easily to six different ventilating positions. DeVAC GlassWalls keep all the good weather inside, all the bad weather out.

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Architects & Contractors specifications in Sweets catalog

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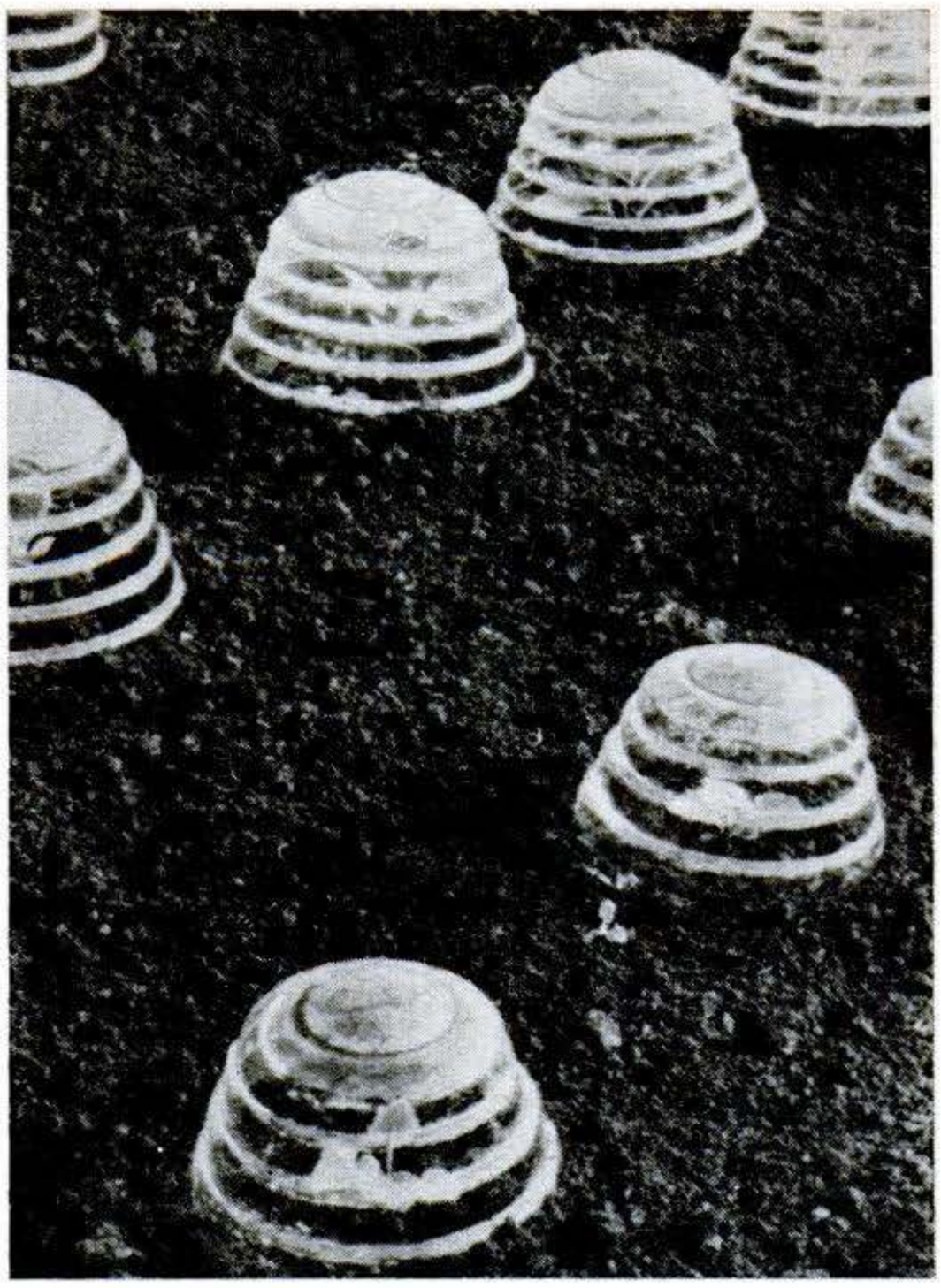
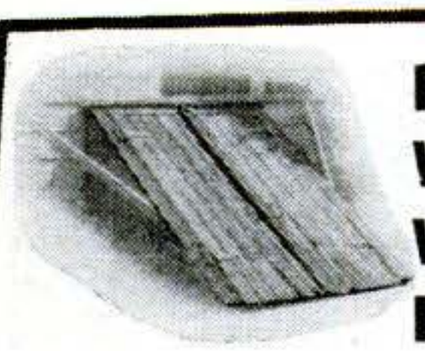


TINY GREENHOUSES. Now each plant can have its own transparent shelter —to speed growth by holding in warmth and moisture. The "Raydomes" are made of Tenite plastic sheeting by the General Plastics Corp. of Marion, Ind.



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with an all-steel BILCO basement door

. . . and your basement entrance will be weathertight, good-looking — for a lifetime. A spring-balanced Bilco door floats open at a touch . . . locks securely . . . costs so little. And you can install it yourself — in just a few hours!

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Please send me your free illustrated folder and name of local dealer.
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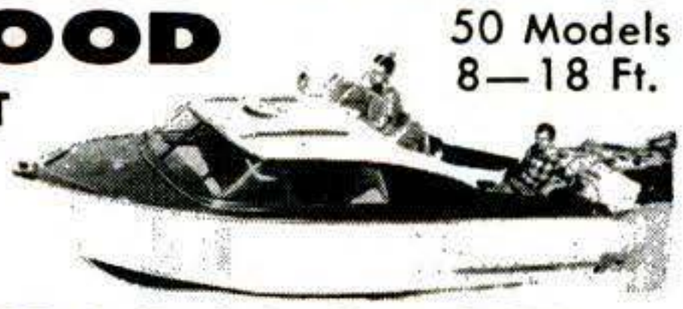

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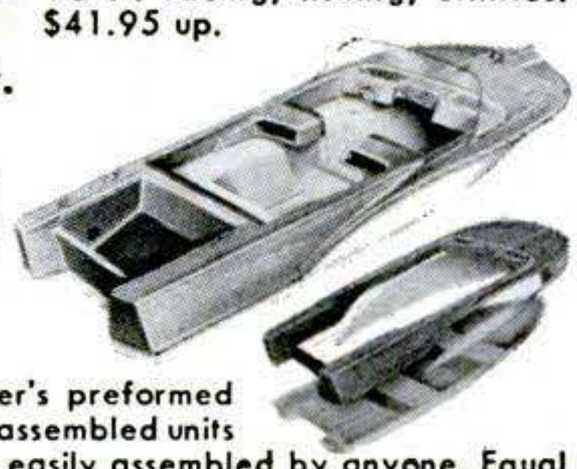
From $299 (at right)

Interlocking units (lower right photo) snap together, bond into 1-piece boat easily assembled in one evening.



Luger's preformed preassembled units are easily assembled by anyone. Equal factory-built yet save ½ to ⅔. FREE catalog has all details, trailers, accessories, paint, Fiberglass supplies.

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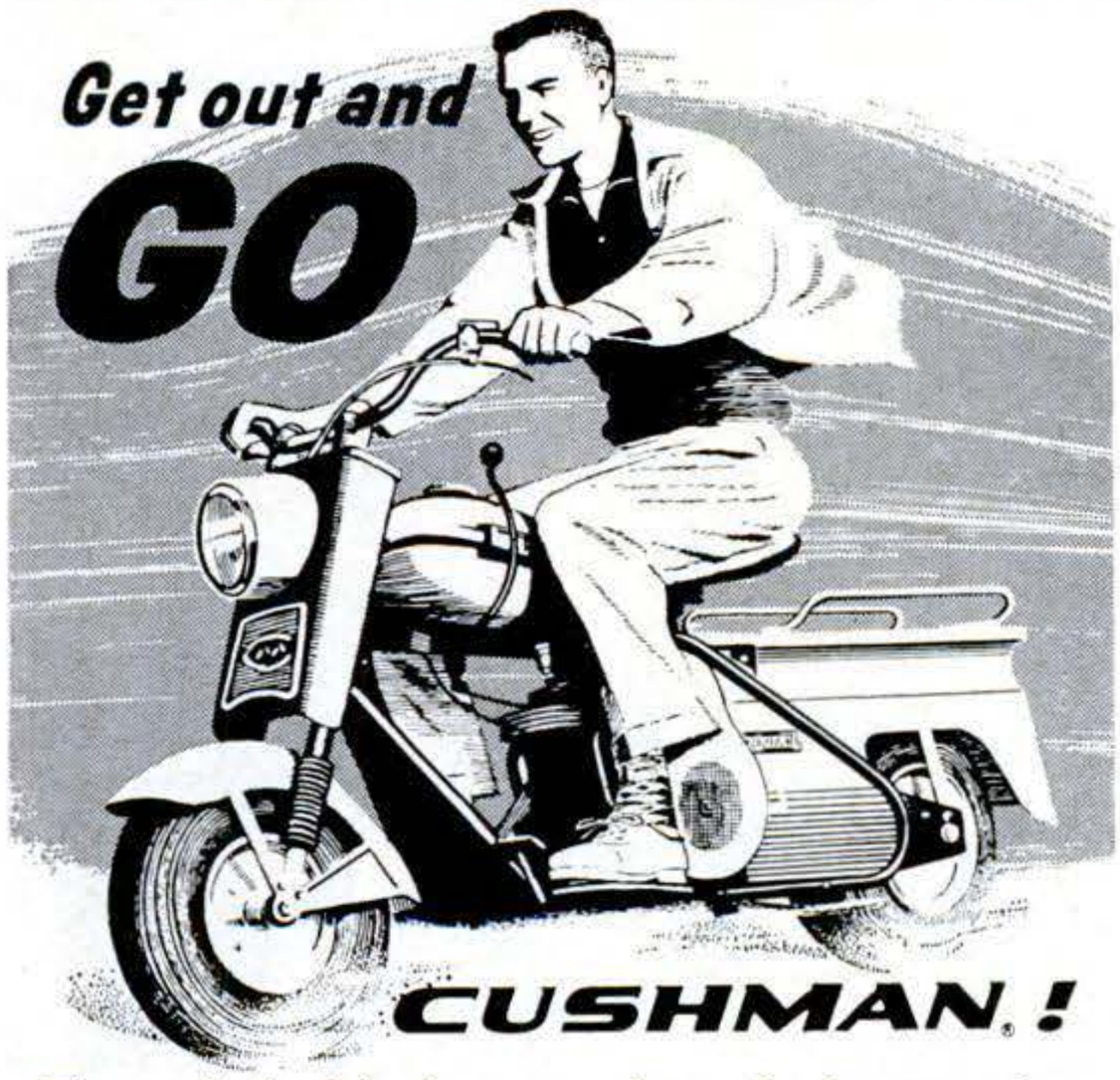
Dept. A-3 9200 Access Rd., Minneapolis 20, Minn.



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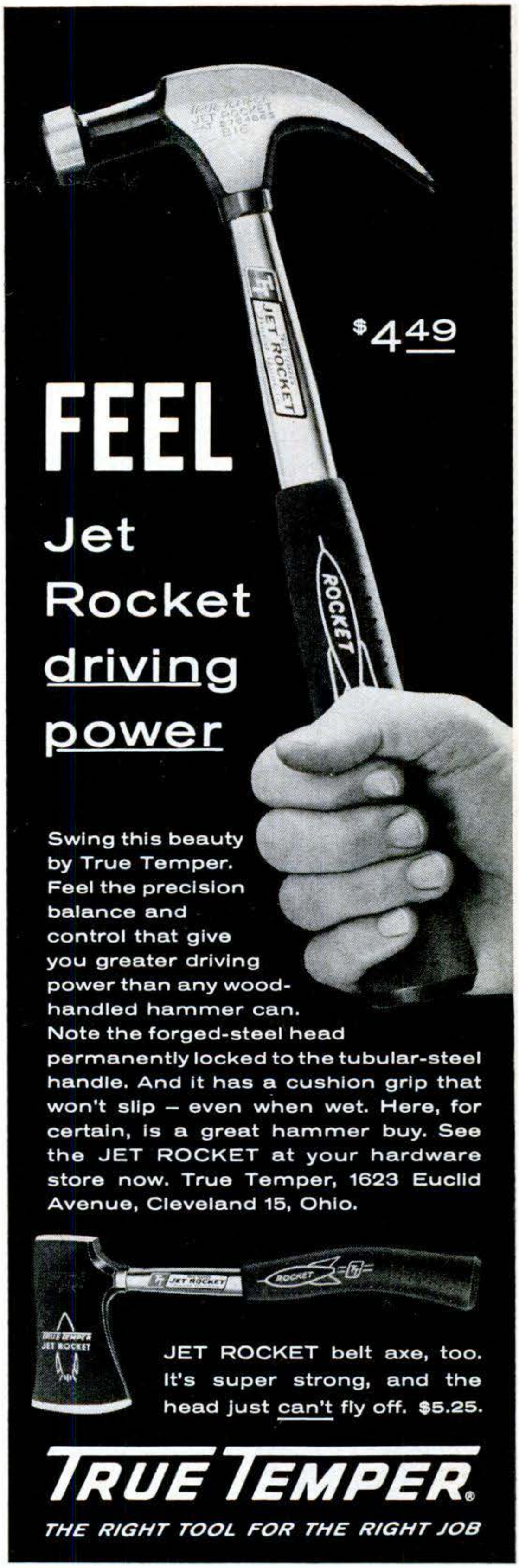

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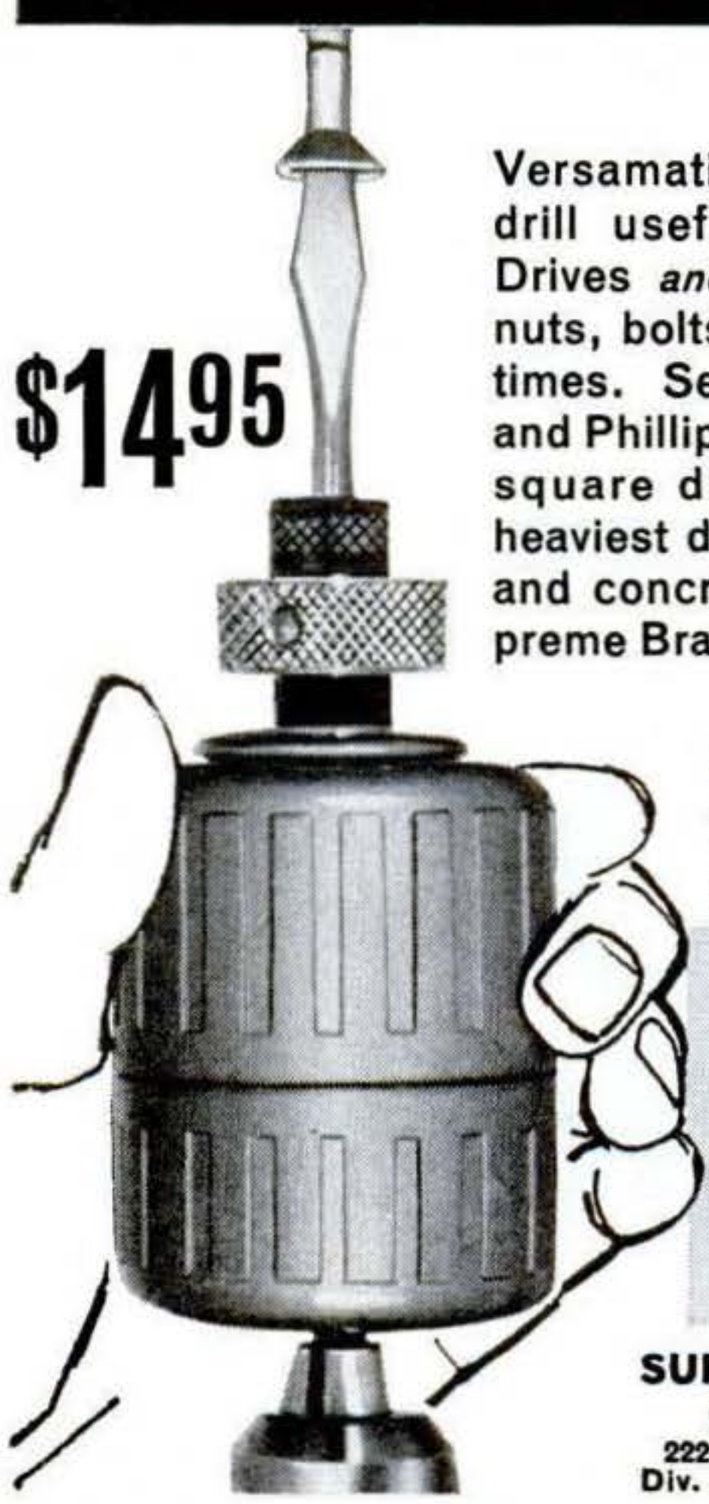

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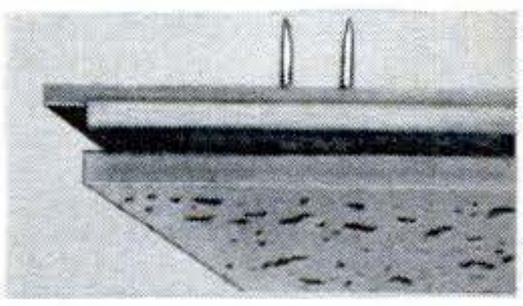

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Unique leg design locks into wood, drives flush, holds tight!

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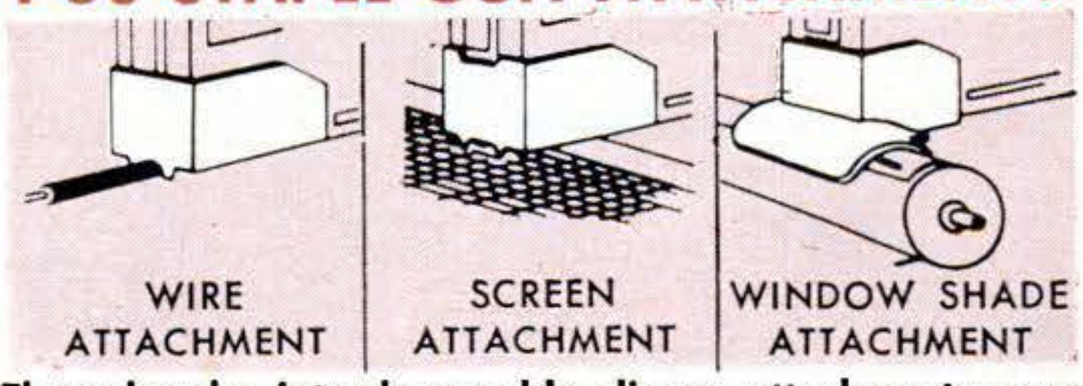

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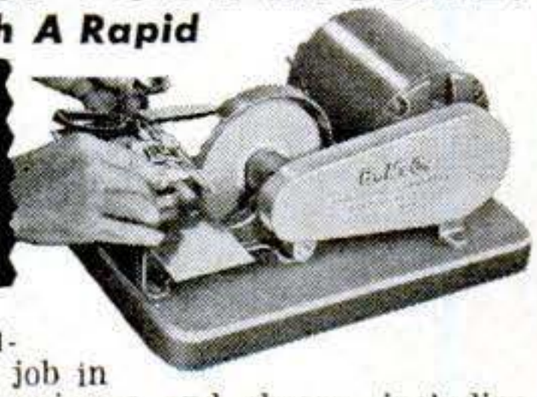

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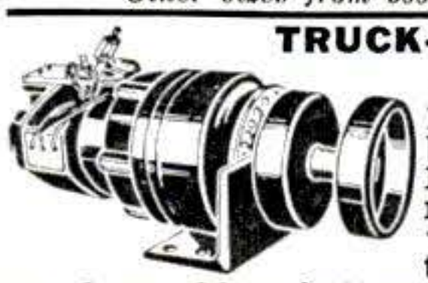

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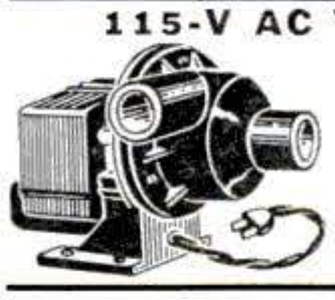

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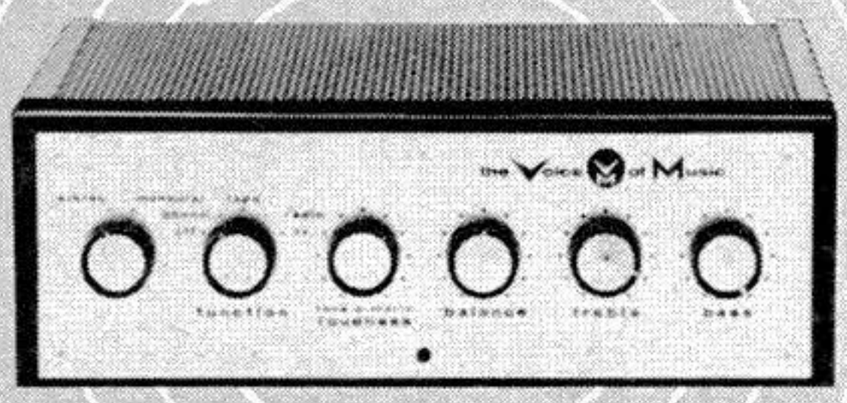

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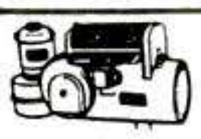

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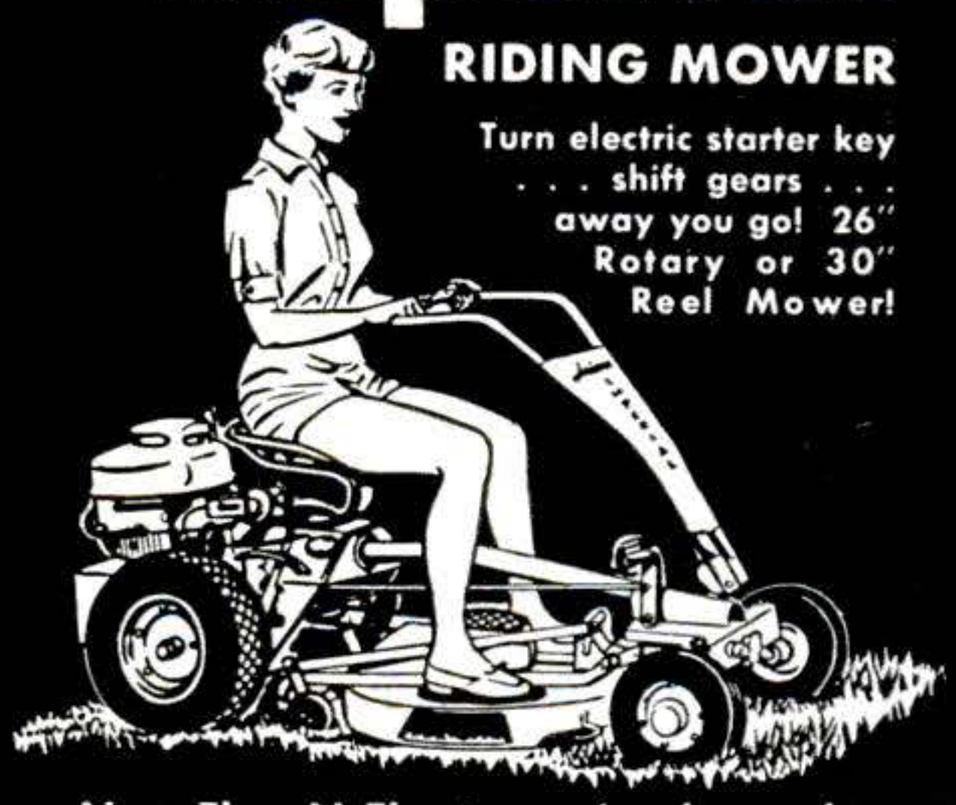

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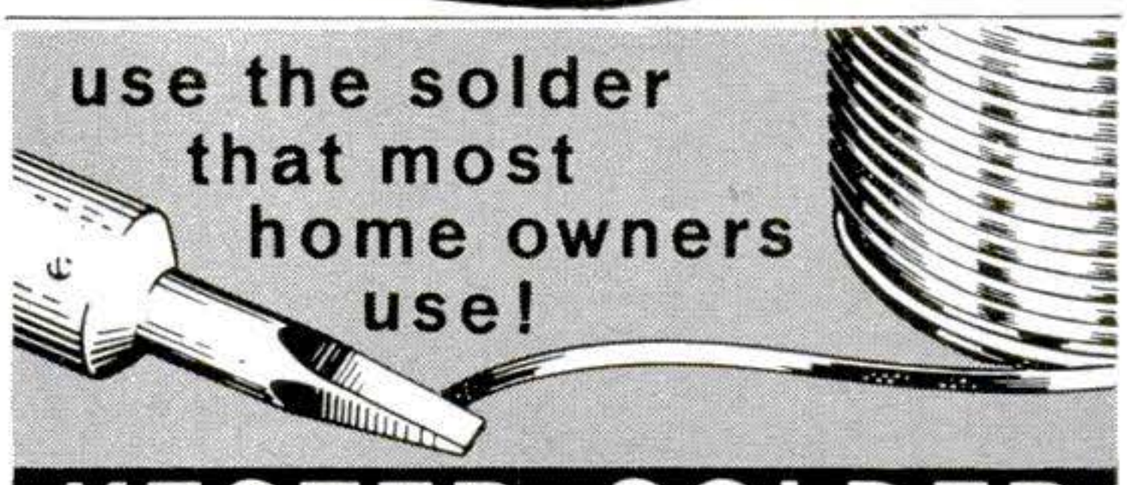

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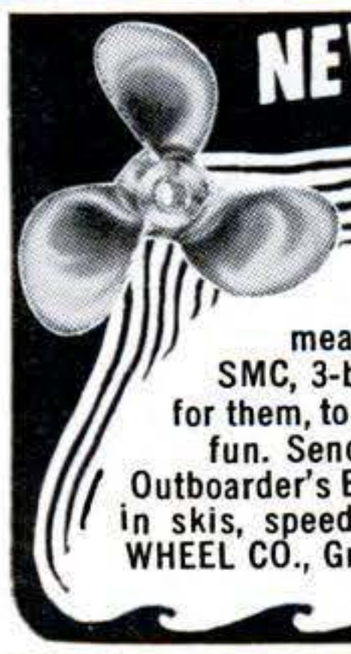

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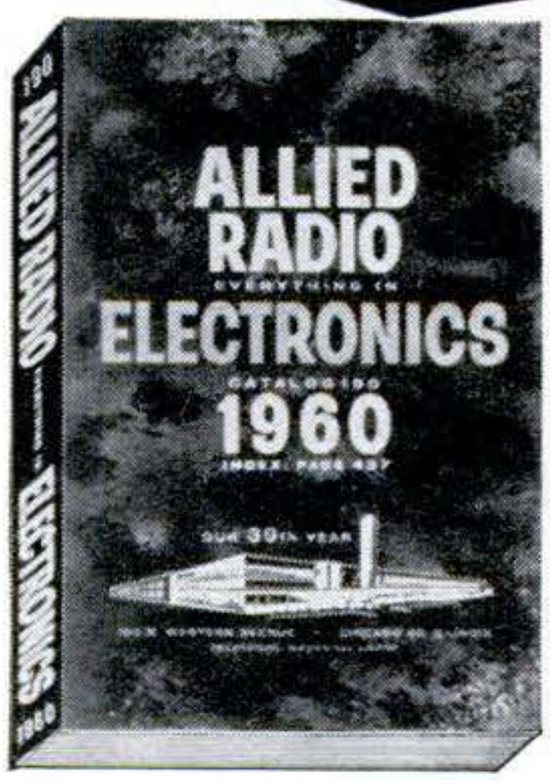

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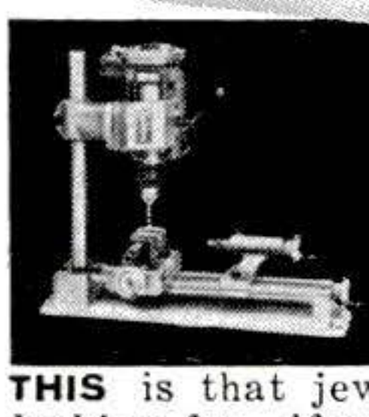

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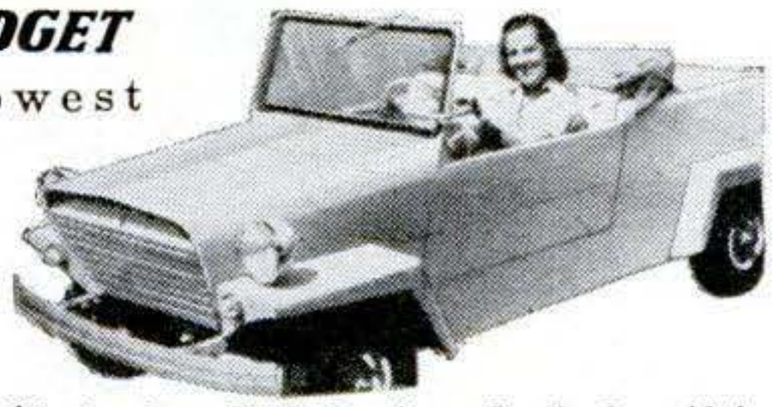

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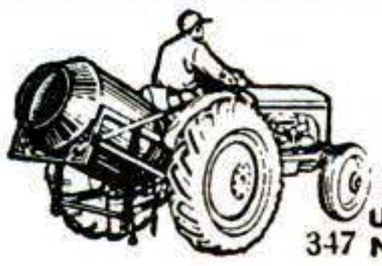

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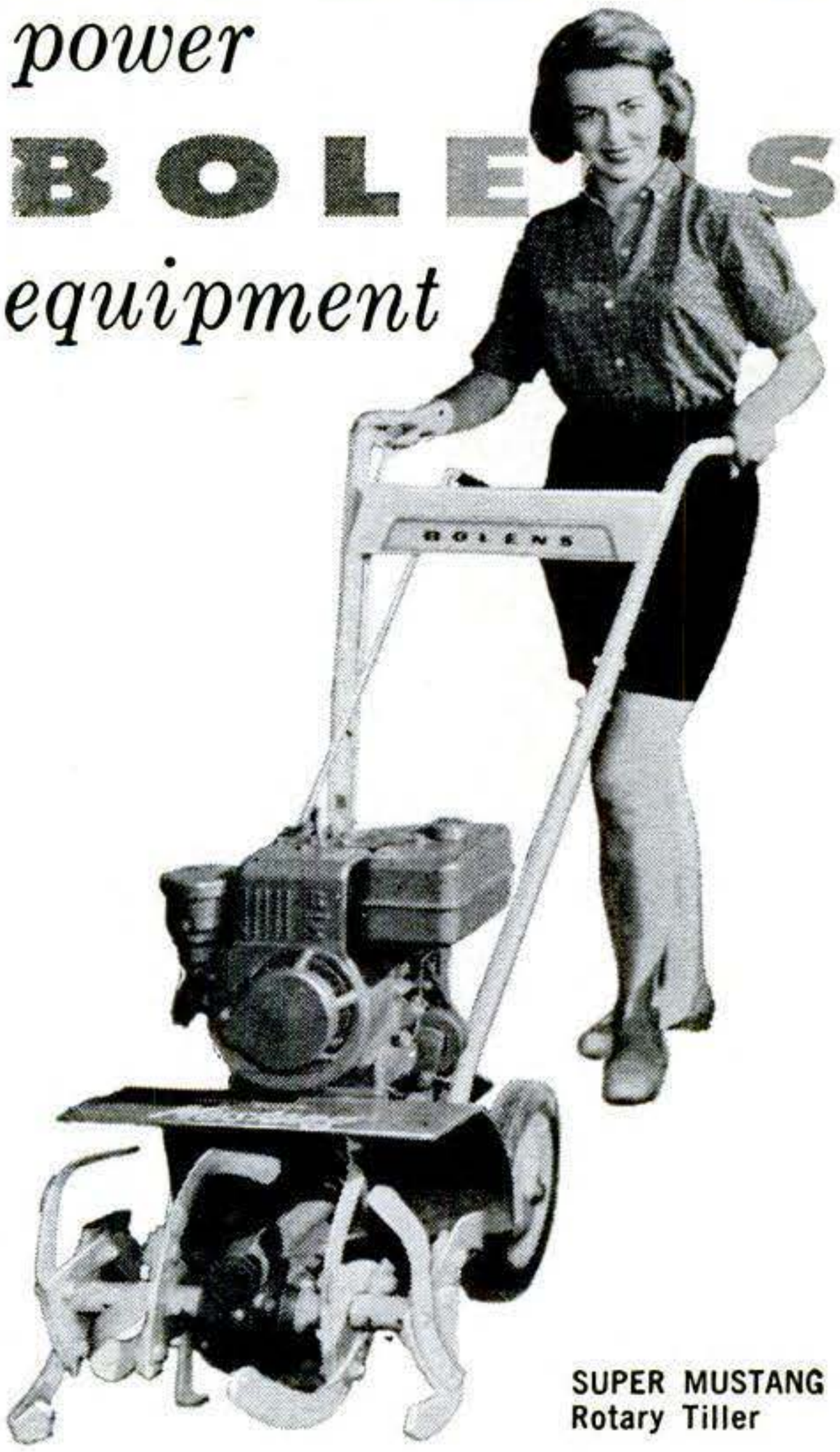

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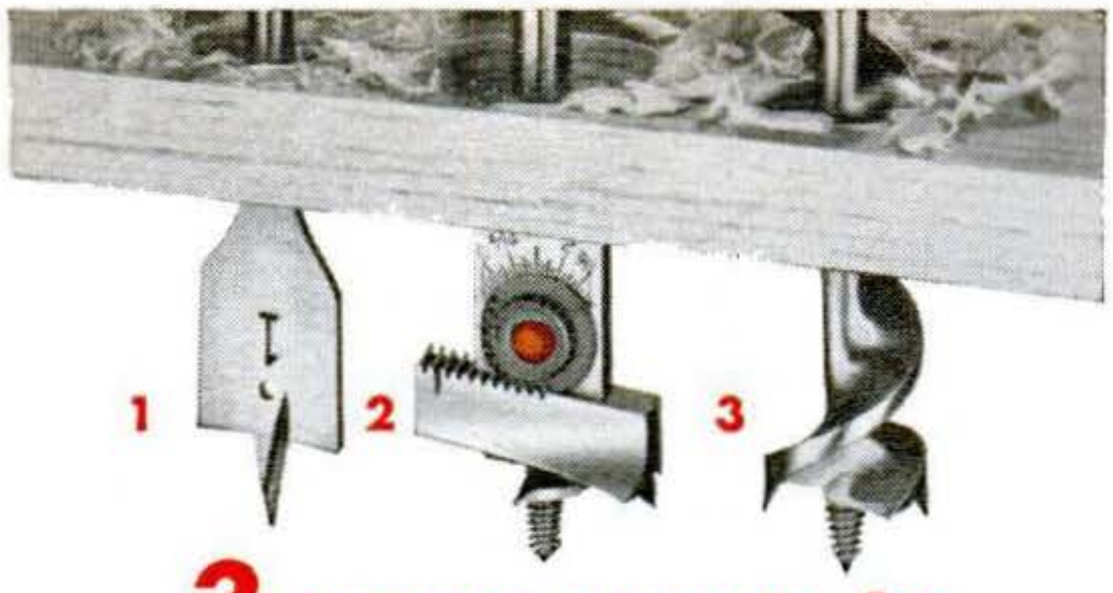

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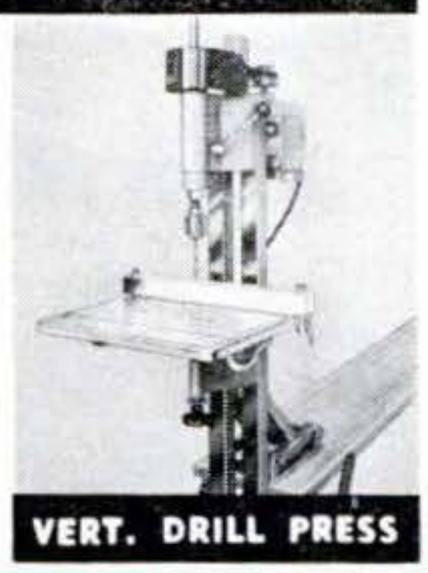

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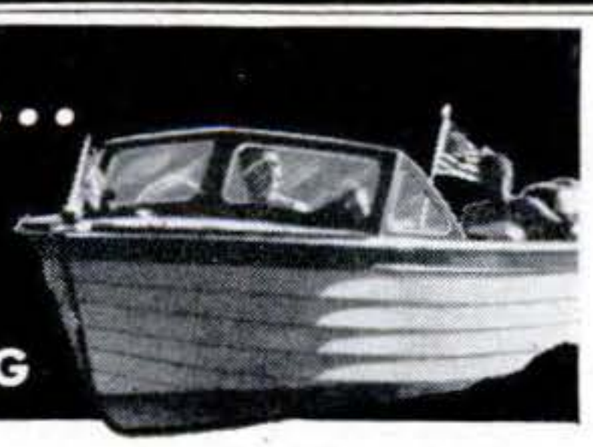

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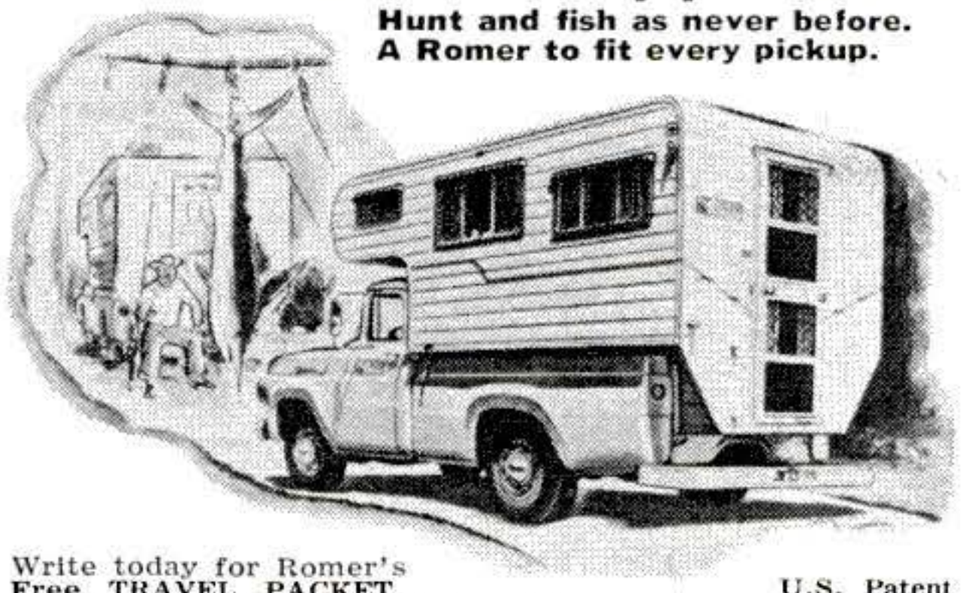

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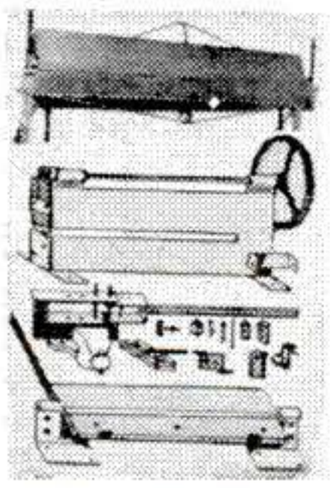

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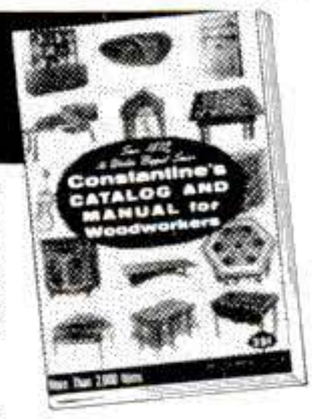

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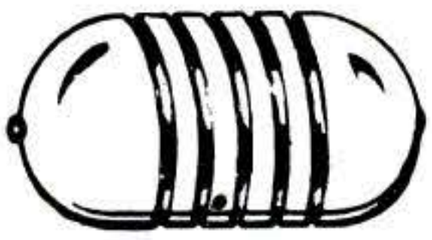

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Advertising, Agencies for Advertisers . . . 53
Agents Wanted . . . 43
Antiques, Relics & Indian Goods . . . 29
Astronautics . . . 5A
Authors Service . . . 52
Auto Supplies & Equipment . . . 2
Auto Trailers . . . 3
Automobiles & Midget Cars . . . 1
Aviation . . . 5

Boats, Outboard Motors . . . 11
Body-Building Courses, Jiu Jitsu, Etc. . . 12
Books & Magazines . . . 23
Business Opportunities . . . 37
Business Service, Information, Name Lists . . . 50
Buy It Wholesale . . . 38A

Cameras, Photo Supplies . . . 34
Camping Equipment & Tents . . . 16
Cartooning, Sign Painting, Chalk Talks . . 54
Coins & Currency . . . 26
Color Photo Finishing . . . 32A
Contests . . . 46

Detectives . . . 47
Do-It-Yourself . . . 66
Dogs, Birds, Hamsters & Pets . . . 17

Educational & Instruction . . . 45
Electric Trains . . . 64B
Electrical Supplies & Equipment . . . 7
Engineering Services . . . 60A
Engines, Motors, Etc. . . . 10

Farms, Other Real Estate . . . 19
Field Glasses, Telescopes . . . 14
For Inventors . . . 60
For Sale Miscellaneous . . . 71
Formulas, Plans, Etc. . . . 39
Frog Raising . . . 18A

Geiger Counters, Treasure Finders . . . 77
Garden Tractors . . . 10C

Help Wanted Reports . . . 42
High-grade Salesmen . . . 44
Hobbies, Collections . . . 31
Home Craftsman . . . 65
Hypnotism . . . 24

Inventions Wanted . . . 61

Jokes, Games, Novelties, Etc. . . . 24A

Language Outfits . . . 48
Live Bait . . . 18

Machinery, Tool Supplies, Etc. . . . 9
Magic Tricks, Puzzles, Etc. . . . 25
Minerals & Precious Stones . . . 30
Miscellaneous . . . 79
Models, Model Supplies . . . 64
Moneymaking Opportunities . . . 38
Motion Pictures, Slides, Sound Equip. . . 33
Motorcycles, Bicycles & Supplies . . . 4
Music, Song Writers & Records . . . 35

Of Interest To Women . . . 70
Old Gold, Jewelry, Watches . . . 67
Old Stamps Wanted . . . 27

Personal . . . 80
Photo Finishing, Photocopies, Etc. . . . 32
Plastics . . . 40
Printing, Multigraphing, Etc. . . . 57
Printing Outfits, Supplies . . . 58
Profitable Occupations . . . 22

Radio, TV, Supplies & Equipment . . . 36
Razor Blades, Shavers . . . 74
Remailing Service . . . 80A
Rubber Stamps & Office Supplies . . . 56

Science & Chemistry . . . 41
Special Services . . . 51
Sporting Goods, Guns, Fishing Tackle, Etc. . . . 15
Stamp Collecting . . . 28
Swap . . . 79B

Tattooing Supplies . . . 75
Trees, Shrubs, Roots & Herbs . . . 20
Trigonometers . . . 9A

Wanted to Buy . . . 72
Watch Repairing . . . 78
Welding, Soldering . . . 8
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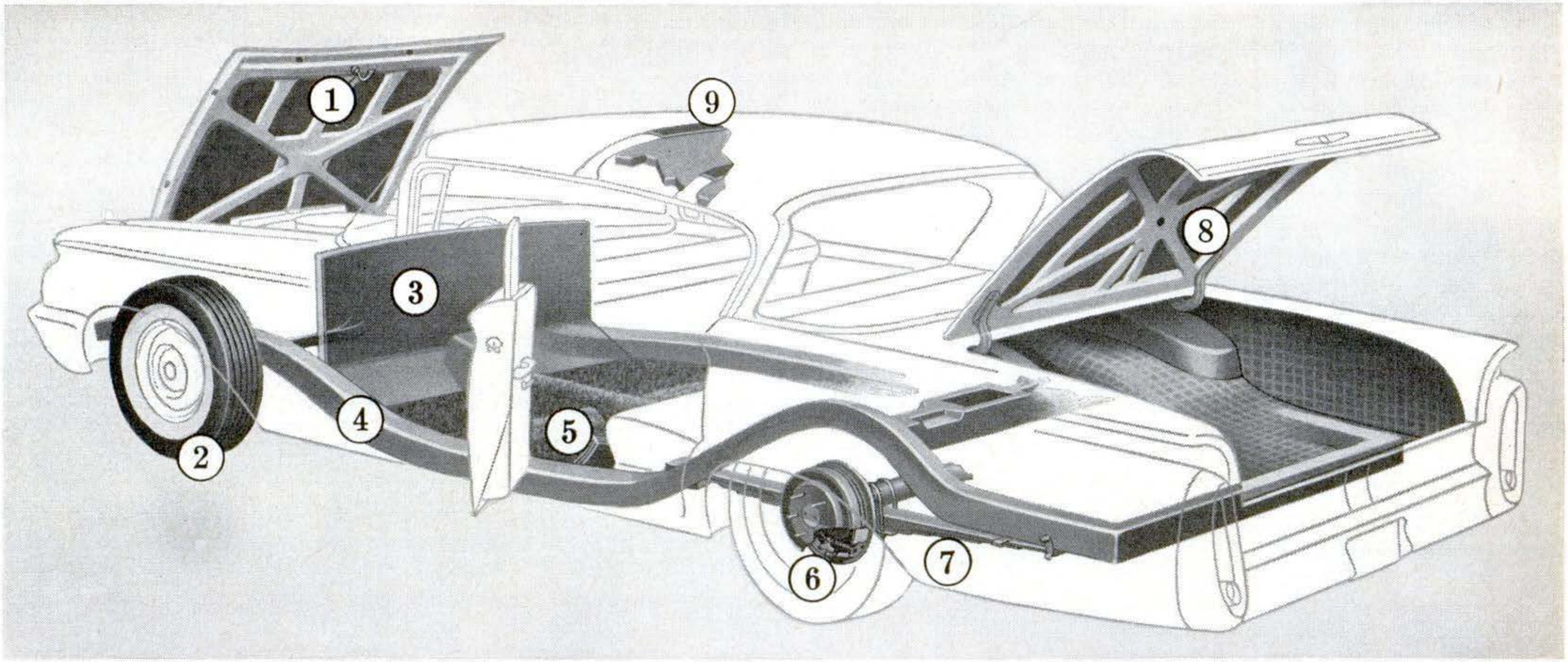

1. To prevent hood flutter and "drumming" use a double, rather than single, panel construction. Sandwich in a thick layer of asphalt-impregnated insulation to absorb engine sound. Hinge from the front for extra safety.

2. For extra traction and a softer ride use large tires (8.00 x 14).

3. To protect front seat passengers from engine sound and heat, use compound insulation for the dash panel. Install a thick blanket of high density glass fiber reinforced with a heavy mastic-impregnated face board.

4. For extra safety, use a box-type frame where the side rails safely surround the passenger compartment. These will act as effective side bumpers, help protect passengers in case of collision.

5. To check road noise, use asphalt-impregnated waffle paper on toe riser and on floor panels in front of seats. Also under rear seat. Next, cover floor panel with a heavy jute pad. Finish with "wall-to-wall" carpeting. Use a mastic deadener on underside of floor panel.

6. To eliminate the need for periodic adjusting, install self-adjusting brakes.

7. For maximum riding comfort install extra wide (2½″), extra long (60″) rear springs with six leaves rather than four.

8. Build deck lid in same manner as hood: double-panel insulated construction. Cover trunk floor with waffle insulation and rubber mat. Install decorative side panels. Leave plenty of room for maximum luggage load. Install spare tire in back of trunk away from normal-usage area.

9. To obtain an even greater degree of protection from heat, cold, and noise, place strips of waffle-felt insulation between roof bows and roof panel. Install four glass-fiber blankets on the underside of the roof panel between the bows.

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[Continued from page 133]

ance. Furthermore, Villchur claims, the air spring is more nearly linear over greater distances of diaphragm movement. This simply means that the suspension system will allow the cone to make larger to-and-fro excursions without introducing distortion.

This feature is necessary if a small speaker is to reproduce the very low frequencies without the aid of a big horn or other large enclosure. Remember that sound is pressure waves in air, and that at low frequencies a speaker has to pump waves up to 35 feet long. A small speaker must make up for its lack of air-grabbing area by pumping over a greater distance, just as you would take longer strokes if you were rowing a boat with undersized oars.

The speaker motor—the voice coil and magnet assembly—must also be designed for a longer front-to-back travel. The push it exerts on the diaphragm must be proportional to the signal over the entire distance of cone travel. In designing for longer voice-coil travel some speaker efficiency must be surrendered. Low efficiency is the most important admitted weakness of this kind of speaker. This is the price you pay to get adequate bass performance in a small space.

Is it really new? Whether or not Villchur invented a new principle of speaker design or merely combined and refined elements already familiar to engineers is bitterly disputed today. But there is no doubt that the commercial success of his speakers changed much of the speaker industry's thinking about loudspeaker efficiency, and touched off a major trend.

Trading amplifier watts for speaker size is now recognized as a fair exchange by most experts, although they disagree on how far you need to go in this direction. And that is all that is really involved in this question of speaker efficiency. With a less efficient speaker you have to have more watts of audio power driving the speaker to produce a given volume level of sound.

In practical terms, a speaker with one- to two-percent efficiency (typical of AR speakers and similar types) needs a 20-watt amplifier to fill the average living room comfortably. Some hi-fi purists would put the minimum requirements even higher to give a greater margin of reserve—say 35 watts.

Any of the better-quality, conventional speakers in an effective enclosure of six to eight cubic feet can give more than adequate volume on the output of a 10-watt amplifier.

Wide range of choice. There is a formidable array of compacts to choose from now, and new ones are showing up with great regularity. They are by no means all alike in design details or in the way they sound. But generally they have these features in common:

- High-compliance suspension.
- Long-throw voice coil.
- Driver and enclosure are delivered only as a unit—matched at the factory.

Only by listening can you judge which speaker will suit you best. If you are limited to an amplifier of 12 watts or less, you may as well confine your ear-testing to the more efficient speakers. Otherwise, be sure that you don't let a simple difference in loudness fool you. Music usually sounds better loud, so adjust the volume control so that each speaker has equal volume, to avoid a bias in favor of the louder one.

It's not surprising that many manufacturers of the newer compact speakers have concentrated on design features that would yield higher efficiency. Possibly the most significant variation is the use of a vented enclosure instead of a tightly sealed box. This is simply a highly sophisticated version of the familiar bass-reflex enclosure. The back wave from the speaker produces sound at the vent opening that reinforces the front wave at very low frequencies. According to its proponents, this scheme enables them to build a more efficient system without sacrificing other desirable qualities.

The special problems of low-frequency reproduction are of unique concern in making a compact-speaker system, but of course the middle and high frequencies must be dealt with, too. Size is not the problem here. But the quality of the higher-frequency reproducers will greatly influence the price of the unit. Ultimately, it may be the differences in the sound of the upper tones, as well as your budget, that determines your choice among competing brands.

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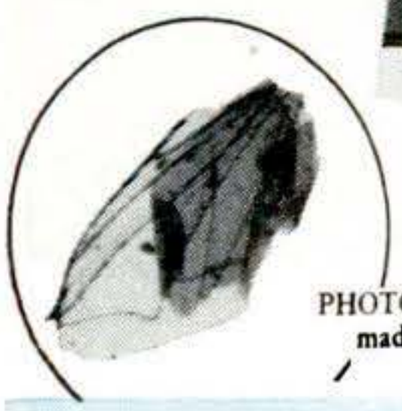

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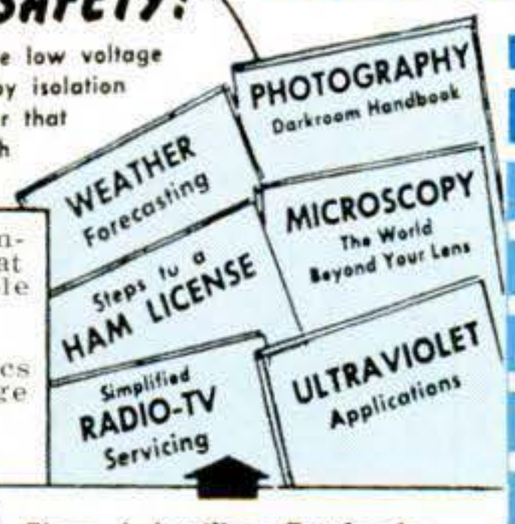

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